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Ranking the Input and Output Data Used to Determine New Source Performance Standard Impacts

Research Corp of New England, Wethersfield, Conn

Prepared for

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RANKING THE INPUT AND OUTPUT DATA USED TO DETERMINE NEW SOURCE PERFORMANCE STANDARD IMPACTS

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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16. ABSTRACT

The purpose of this document is to present the results of a study to determine the impact of new source performance standards on nationwide emissions. The work presented covers 14 potential pollutants from approximately 200 source categories for the year 1985. The results are being used by EPA as input to the development of an overall standard setting strategy. The report contains information regarding controlled and uncontrolled emission factors, State emission limitations, industrial capacity, utilization, growth and retirement rates. The results of this study have been published as three volumes which encompass ten separate documents. This document contains the main text and Appendices A through C of Volume III.

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by

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Contract No. 68-02-1382

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Prepared for

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Office of Air and Waste Management
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Research Triangle Park, North Carolina 27711

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FOREWORD

During 1974, two studies were initiated that ultimately resulted in the establishment of priorities for developing and promulgating New Source Performance Standards (NSPS). The procedures used to determine these priorities produced a great deal of information that is believed to be useful in the industries involved and, accordingly, is being published in this series of reports (EPA-450/3-76-017, EPA-450/3-76-018, EPA-450/3-76-019, and EPA-450/3-76-020). This information is organized as follows:

EPA-450/3-76-017 discusses (1) the mathematical model (Model IV) used to determine NSPS impacts over a 10-year period; (2) the methods used to attain input variables; and (3) the summary tables which are the heart of this study. Included in the summary tables are data related to (1) emission, growth, and replacement rates; (2) present and future production and capacity; (3) nationwide emissions; and (4) NSPS impact. These tables include information on 13 pollutants and nearly 200 stationary source categories.

EPA-450/3-3-76-018-a, -b, -c, -d, -e, and -f are the calculation sheets, showing how the input variables reported in EPA-450/3-76-017 were derived. All information sources, assumptions, and calculations are documented and explained. The appropriate worksheets are arranged alphabetically in the following volumes:

018-a - Stationary Combustion Sources
018-b - Chemical Processing Industries
018-c - Food and Agricultural Industries
018-d - Mineral Products Industries
018-e - Metallurgical Industries
018-f - Miscellaneous Sources (Evaporation Losses, Petroleum
Industry, Wood Products Industry, and Assembly Plants

The 018-a -f series is of interest only to those concerned with the detailed calculations used to determine the Model IV input variables.

EPA-450/3-76-019-a provides additional results and information produced during the priority study. Its major purpose is to describe the computer program used to rank all the Model IV input and output variables by pollutant (these rankings are reported in 019-b and -c). In addition, it contains (1) summaries of the control systems considered "best" for each source, (2) equipment retirement ages, and (3) emission trends for each source category.

EPA-450/3-76-019-b and c present the computer-generated ranked data for each pollutant. Ranking is from highest to lowest for each of the 21 variables, e.g., A (nationwide capacity) and E_u (uncontrolled emission rate). Volume 019-b contains ranked data for particulate, nitrogen oxide (NO_x), and sulfur oxide (SO_x) sources. In Volume 019-c, the remaining pollutant sources are ranked: hydrocarbons, carbon monoxide (CO), fluorides, hazardous material, acid mist, lead, ammonia, sulfides, chlorine, and trace metals.

EPA-450/3-76-020, the final document in this series, takes the objective impact values from EPA-450/3-76-017, adds subjective judgements, and uses these combined criteria to produce a priority list for NSPS development. The report then calculates nationwide emission trends over the next 15 years for each criteria pollutant (particulate, SO_x, NO_x, hydrocarbons, and CO) based on a series of scenarios (e.g., no NSPS, 20 NSPS per year, etc.)

In summary, documents EPA-450/3-76-017 and 020 present the results of this study. Each stands alone, but they also complement each other, with 020 building on the results of 017. The remaining documents (018-a -f and 019-a -c) present additional and/or more detailed information derived from the impact and priority studies.

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1.0 SUMMARY

Section 111 of the Clean Air Act charges the Administrator of the Environmental Protection Agency with the responsibility of establishing Federal standards of performance for new stationary sources which may significantly contribute to air pollution. These new source performance standards (NSPS) will reflect the degree of emission limitation achievable through application of the best demonstrated control methods, considering cost. Due to limited manpower and funding, it is not feasible to set standards for all sources simultaneously and, therefore, an overall strategy is being developed to delineate the priorities by which such standards should be set. This strategy will focus attention on those sources for which NSPS control would have the greatest impact on reducing the quantity of atmospheric emissions. Estimates of the projected differential in emissions with and without anticipated NSPS is to serve as the basis for determining these standard-setting priorities.

This report is the third and final document presenting the results of a study to develop such estimates for approximately 200 source categories. These "emission impact" calculations have been performed using a generalized priority rating system developed by EPA known as Model IV.(1) The model has been computerized to permit refinement of data as new or more up-to-date information becomes available.

EPA-450/3-76-017, *Impact of New Source Performance Standards on 1985 National Emissions from Stationary Sources*, presents the detailed results of the study and contains appropriate conclusions and recommendations. In-depth discussion of the model factors, source categories, pollutants evaluated, calculation methodology and special case considerations are also included. EPA-450/3-76-018-a th[illegible] 018-f contain the detailed calculation sheets developed for each of t[illegible] source categories. These sheets include additional information regarding historical trends within the category, plant locations and sizes, projections of growth and the potential for change, alternate sources of data, value and confidence levels of the input variables, alternate control techniques and interrelationships of various industrial categories. The present volume, EPA-450/3-76-019-a, along with -019-b and -c, describes the computer program used to develop the emission values and outlines the input requirements for future use by EPA or TRC personnel. Several new variables not discussed in EPA-450/3-76-017 are defined and the program has been written such that the output can be automatically "ranked" according to any one of several preselected options. Ranked data are presented in a form such that the present volume, EPA-450/3-76-019-a, along with -019-b and -c, can be used as a comprehensive reference handbook. The present volume contains in table form a listing of the various control devices or techniques representing best control applied to new sources and the source categories to which they were deemed applicable, control efficiencies, and installation status. It also contains a list of source category retirement ages, estimates of anticipated future emission trends and discusses how investigators may further utilize the information developed during this project.

2.0 INTRODUCTION

The Environmental Protection Agency (EPA) is preparing to establish a long-range schedule for promulgating new source performance standards (NSPS). In order for these future NSPS to be most effective, an overall strategy or plan of action is being developed so that priorities for standard setting can be established. This master plan will take into account the impact of standards on atmospheric emissions, pollutant priorities, completion dates of research and development studies on control technology, availability of test methods, manpower for standards development, geographical distribution of sources, effects on ambient air quality and anticipated economic factors. The purpose of this series of documents is to present the results of a program to calculate the impact of NSPS on air pollutant emissions from sources within the United States.

These calculations have been performed using a generalized priority rating system known as Model IV,(1) which mathematically expresses the differential in atmospheric emissions that could be expected with and without NSPS. For example, a maximum emission differential would be observed for a source for which a stringent standard of performance was technically feasible, but for which there were no existing state emission limitations. On the other hand, a minimum or zero emission differential would be observed for a source if a standard of performance representing best control technology were generally equal to existing state regulations. This priority rating system is applied to approximately 200 source categories and the results are listed in decreasing order of potential emission reduction in EPA-450/3-76-017, Impact of New Source Performance Standards on 1985 National Emissions from Stationary Sources.

The model by which emission impact is calculated uses 1975 capacity as the baseline to which estimated growth and obsolescence rates over the next ten years are applied to obtain the new and modified capacity that could be regulated by NSPS in the period 1975 to 1985. The best available level of control is then applied to this capacity to determine the level of emissions under NSPS control in 1985. For comparison, another set of emission levels is determined for 1985 by applying to this same new and modified capacity the control levels stipulated by state regulations, or (in the absence of applicable regulations) uncontrolled emission levels. Both sets of emission levels represent maximum values based on capacity. They are then tempered by a capacity utilization factor to convert emission levels from operation at capacity to operation at production rates anticipated in 1985. The difference between the two values of emission levels represents the control effectiveness of NSPS for a specific pollutant within a source. This is the first step in determining the order of standard setting since priority attention should be given to source categories for which the greatest potential for emission reduction can be expected.

Section 3.0 of this report presents a description of Model IV and the factors which comprise it. The computer program input requirements and output format are also described. Source category-pollutant control techniques are outlined along with anticipated levels of efficiency and the installation status as determined from the literature. Estimates of anticipated future emission trends are presented in light of their relationship to present emission levels and the future use of the model and the results obtained from its use are also discussed.

Results of our study were presented in EPA-450/3-76-017, ranked on the basis of potential for emission reduction. Since other uses of the data can be readily conceived they have been subsequently ranked by an additional 20 options. EPA-450/3-76-019-b, *Ranked Input and Output Data Used to Determine Impact of New Source Performance Standards for Particulate Matter, Nitrogen Oxides, and Sulfur Oxides*, and EPA-450/3-76-019-c, *Ranked Input and Output Data Used to Determine Impact of New Source Performance Standards for Hydrocarbons, Carbon Monoxide, and Other Pollutants*, present this ranked data on a pollutant by pollutant basis for all 21 options.

The majority of the results, calculations and rationale is presented in EPA-450/3-76-017 and in EPA-450/3-76-018-a through -f. The reader should be familiar with the content of these volumes before attempting to utilize any information presented in this the present volume or in EPA-450/3-76-019-b or EPA-450/3-76-019-c.

3.0 DISCUSSION

3.1 Background

The Clean Air Act(2) of 1970, building on prior federal, state and local control agency legislation and experience, authorized a national program of air pollution prevention and control which included the following major approaches:

(1) National Ambient Air Quality Standards (Sections 109 and 110).

(2) Emission Standards for Moving Sources (Sections 202, 211 and 231).

(3) National Emission Standards for Hazardous Air Pollutants (Section 112).

(4) Standards of Performance for New Stationary Sources (Section 111).

Standards of Performance for New Stationary Sources are commonly referred to as new source performance standards or NSPS. These are emission standards, established by EPA, which reflect the degree of emission limitation achievable through the application of the best adequately demonstrated system of emission reduction, taking into account the cost of achieving such reduction. They apply only to new or modified sources, with one exception: if the standard is for a "designated" pollutant (i.e., a pollutant which is neither a "criteria" nor a "hazardous" pollutant), then a separate standard is established for existing sources by state agencies (Section 111d).

The major objective of new source performance standards is to obviate future air pollution problems rather than to correct them after the fact. The most practical time, from both an economic and technical standpoint, to install pollution control equipment is during the construction phase of a new facility. Add-on systems or devices are more costly than those incorporated in the plant design and they may not represent the application of best technology due to the constraints placed on them by existing structures and process considerations. Pollution control equipment, designed as an integral part of a process or operation, is the most effective means of reducing emissions at the least possible expense. In many instances, proper selection, design and incorporation of controls can result in zero cost or even a savings for new plant operations.

Since NSPS require best demonstrated control technology on new or modified plants, they have the effect of preventing significant quantities of emissions from rapidly growing industries and from extensive plant modification efforts. It is an effective means of minimizing air quality degradation, since the standards can be reviewed periodically and modified to reflect advancements in the state-of-the-art of control technology. Future plants or plant modifications would then be subject to the new standard, thus preventing the degradation that would result from the application of "static" regulations to growing sources. In addition, pollutants which are neither "criteria" nor "hazardous" may be controlled for existing sources through application of Section 111(d) of the Clean Air Act. These pollutants are defined as "designated" pollutants.(3)

Due to limited manpower and funding, it is not feasible to set standards on all sources simultaneously and immediately. Accordingly, an overall strategy to delineate priorities is being developed.

These priorities are being determined by evaluating the quantitative impact of a standard in terms of emission reduction for a group of sources. Superimposed upon this are other priority and timing factors such as lead times necessary to develop applicable control methods or test procedures and manpower availability.

3.2 Model IV

Several models have been developed by the EPA for the determination of priorities over the past few years. The first model provided a comparison of source categories based on total atmospheric emissions of all pollutants, availability of control technology, and other factors. The second model focused on the need for individual priorities for each pollutant and attempted to restrict rating criteria to factors selected from a generalized strategy for the pollutant. Impact on emissions was a prime criterion in all cases, but impact was expressed on a relative scale. The third model attempted to emphasize impact, but the relative scale concept was retained. Because impact was expressed in a relative way, the model did not provide a system amenable to gradual refinement as available information was improved. Other models developed by EPA have taken into account toxicity, exposure, ambient air concentrations or population density. These models are generally complex and not amenable to modification or refinement in addition to presenting impact on a relative scale.

Model IV, which is developed below, is amenable to data refinement and provides a quantitative estimate of anticipated impact of standards of performance in preventing atmospheric emissions.

The additional control potential of new or revised standards of performance stems from the application of emission standards that are more stringent than those presently applied to construction and modification. This potential, for a specified time period, is expressed as

$$(T_S - T_N)$$

Where: T_S = Emissions under baseline year control regulations

T_N = Emissions under new or revised standards of performance.

To calculate the control potential of standards of performance, other factors must be considered, such as the portion of growth requirements that can be satisfied from present unused capacity and the obsolescence and replacement rates of existing facilities. Such a comparison can be expressed mathematically.

The following notation is used in the development of the relationship between projected emissions under baseline year (1975) regulations and NSPS control.

T_S = total emissions in i^{th} year under baseline year regulations (tons/yr).

T_N = total emissions in i^{th} year under new or revised NSPS which have been promulgated in the j^{th} year (tons/yr).

T_U = total emissions in i^{th} year assuming no control (tons/yr).

T_A = total emissions in baseline year under baseline year regulations (tons/yr).

T_E = total emissions in i^{th} year under baseline year regulations for the production capacity on line prior to the j^{th} year and still operating in the i^{th} year (A-B), (tons/yr).

T_{UE} = total emissions in i^{th} year assuming no control for the production capacity on line prior to the j^{th} year and still operating in the i^{th} year (A-B), (tons/yr).

K = normal fractional utilization rate of existing capacity, assumed constant during time interval.

A = baseline year production capacity (production units/yr).

B = production capacity from construction and modification to replace obsolete facilities (production units/yr).

C = production capacity from construction and modification to increase output above baseline year capacity (production units/yr).

P_B = construction and modification rate to replace obsolete capacity (decimal fraction of baseline capacity/yr).

P_C = construction and modification rate to increase source capacity (decimal fraction of baseline capacity/yr).

E_S = allowable emissions under existing regulations (mass/unit capacity).

E_N = allowable emissions under standards of performance (mass/unit capacity).

E_U = emissions with no control (mass/unit capacity).

For the purpose of this study the i^{th} year is defined as 1985 and the j^{th} year, 1975.

Assuming that capacity lost due to obsolescence is replaced by construction and modification, as schematically shown in Figure 3-1, then,

$$T_S = E_S\ K\ (A - B) + E_S\ K\ (B + C)\ \ldots\ldots\ldots\ (1)$$

and

$$T_N = E_S\ K\ (A - B) + E_N\ K\ (B + C)\ \ldots\ldots\ldots\ (2)$$

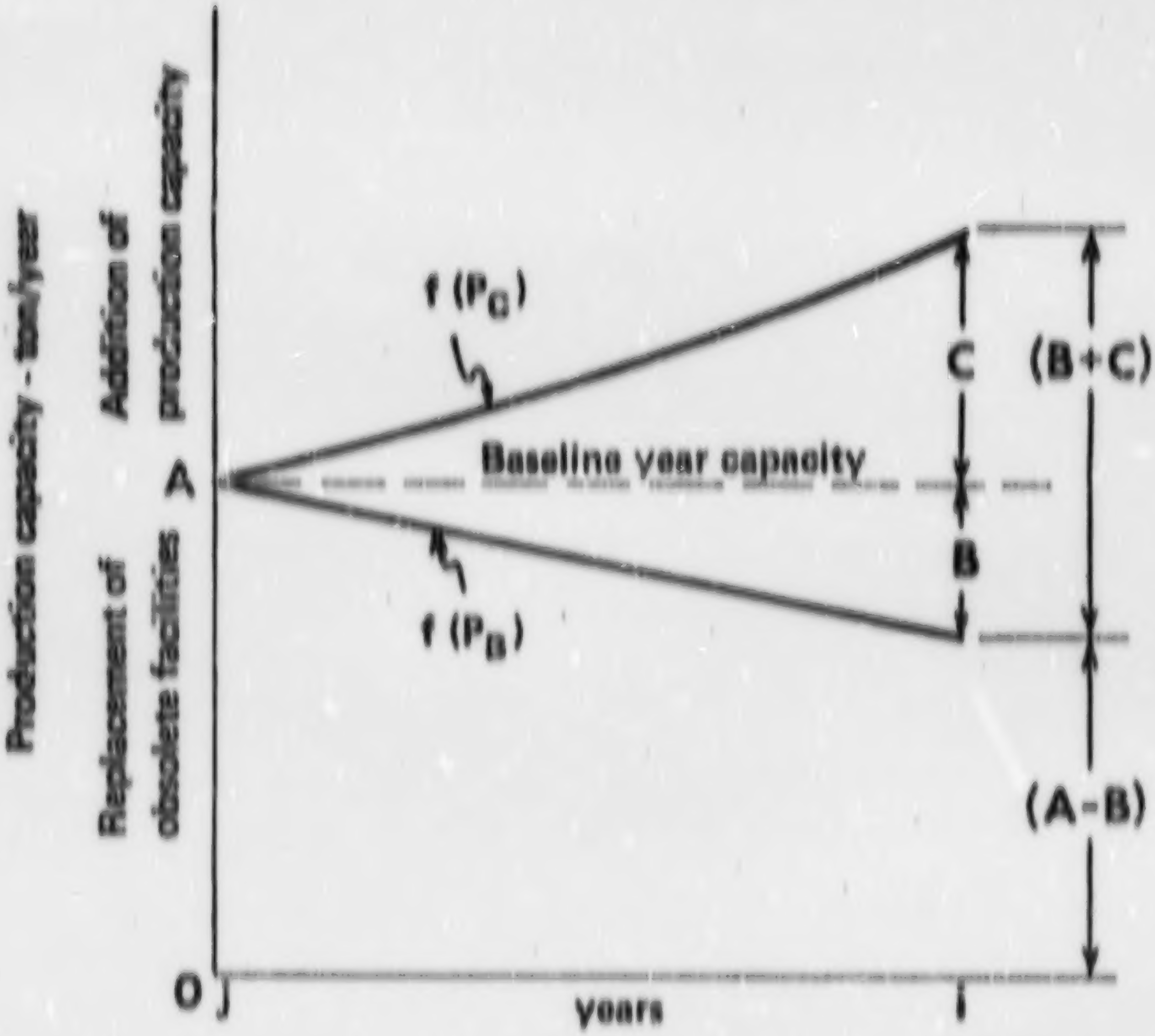
$$T_S - T_N = K\ (B + C)\ (E_S - E_N)\ \ldots\ldots\ldots\ldots\ (3)$$

Values of B and C are determined as follows:

(a) If compound growth is assumed,

FIGURE 3-1

Applicability of NSPS
to construction and modification


Production capacity - tons/year
Addition of production capacity
Replacement of obsolete facilities
A
0
f (P_C)
f (P_B)
Baseline year capacity
C
B
(B+C)
(A-B)
j
years
i

(A-B) = capacity regulated by existing limitations

(B+C) = capacity regulated by NSPS

$$B = A\left[(1 + P_B)^t - 1\right] \quad (4)$$

$$C = A\left[(1 + P_C)^t - 1\right] \quad (5)$$

(b) If simple growth is assumed,

$$B = AtP_B \quad (6)$$

$$C = AtP_C \quad (7)$$

where:

t = elapsed time, years

In addition, the following values may be calculated:

$$T_A = E_S KA \quad (8)$$

$$T_U = E_U K\,(A - B) + E_U K\,(B + C) \quad (9)$$

$$T_R = E_S K\,(A - B) \quad (10)$$

$$T_{UR} = E_U K\,(A - B) \quad (11)$$

Further refinement of the model may be realized for cases where E_S and/or K for new and existing facilities differ. In this case,

$$T_S = K_1 E_{S_1}\,(A - B) + K_2 E_{S_2}\,(B + C) \quad (12)$$

where:

$E_{S_1} = E_S$ for existing plants

$E_{S_2} = E_S$ for new plants

K_1 = K for existing plants

K_2 = K for new plants

If there is only a single value of either K or E_S, the equation would be written accordingly.

Therefore,

$$T_S - T_N = K_2 (B + C) (E_{S_2} - E_N) \quad \ldots\ldots\ldots\ldots (13)$$

Section 111(d) of the Clean Air Act requires the States to regulate designated pollutants from existing installations for sources to which NSPS have been applied. To handle this situation, a slight modification to the model is necessary. T_U, T_A and T_S are the same as for criteria pollutants. T_N is redefined, however, as

$$T_{ND} = E_{111(d)} K (A - B) + E_N K (B + C) \quad \ldots\ldots\ldots\ldots (14)$$

Where:

$E_{111(d)}$ = allowable emissions under state regulations as required by Section 111(d) of the Act.

T_{ND} = total emissions in i^{th} year under Section 111(d) and NSPS regulations.

3.3 Computer Program

3.3.1 General

The Model IV computer program is designed to calculate the variables T_A, T_U, T_S, T_N, B and C and the impact on pollutant emissions, $(T_S - T_N)$. The program requires the industrial prime variables K, A,

F_B and F_U and the emission prime variables E_S, E_U and E_N as input for these calculations.

The original computer program was developed to perform these basic calculations and a listing was presented in Volume I. Subsequently, the program was modified to increase its overall utility to the user and to render it more amenable to future refinement of data as new information becomes available. This original program was very general ans accomplished only the most basic calculations; the others required manual efforts. In summary, the following changes have been made to the deck:

1. Calculation of T_S can incorporate different fractional utilization factors, K, and different allowable emissions, E_S, for new and existing facilities.

2. Calculation of T_U and T_N can incorporate different fractional utilization factors, K, for new and existing capacity.

3. Calculations for designated pollutants can be accomplished.

4. The output values are appropriately rounded off so as to offset the superficial "accuracy" of machine calculated values.

5. Cases for which there was no demonstrated control technology are printed out in the main listing but are distinguished from the other cases with an asterisk (*).

6. The printout is presented in a two page format--the first page summarizing all input values and the second page summarizing all calculated output values.

7. The program output can be ranked by any one of 21 variables.

8. Three additional output values are calculated--T_B, T_{UB} and $(1 - E_N/T_S)$.

A listing of the new program is provided in Appendix A.

3.3.2 Input

Figure 3-2 shows the coding form to be used to input data for the calculation program. The program will handle as many sources as computer storage space allows with each source having a two-card input. Criteria and designated pollutants must be handled separately because of their different output table heading requirements. Cases are batch run on a pollutant basis.

As shown in Figure 3-3, there are four basic sections to the program input. The first consists of control cards that provide the necessary commands to "initiate" program functions. These will vary with the specific requirements of the computer software available to the user.

The second set of input cards consists of format instructions for the output. These cards keep the output parameters, which have variable field sizes, centered in their respective columns on the printed output page. A copy of the format control cards is provided in Appendix B.

The next card controls the order of output data and the parameter by which the sources will be ranked. The first value, ISW, having values of +1, -1, 0 gives the instruction as to whether the data are to be ordered in ascending, descending, or as input form, respectively. The second parameter, IOW, having an integer value between 1 and 21 as outlined in Table 3-1, keys the procedure to the variable by which the sources are to be ranked. (If no ranking is desired, set ISW = 0 and IOW = 1). The pollutant name is listed on the following card as it will appear on the output printed page as part of the table heading.

FIGURE 3-2

MODEL IV INPUT CODING FORM

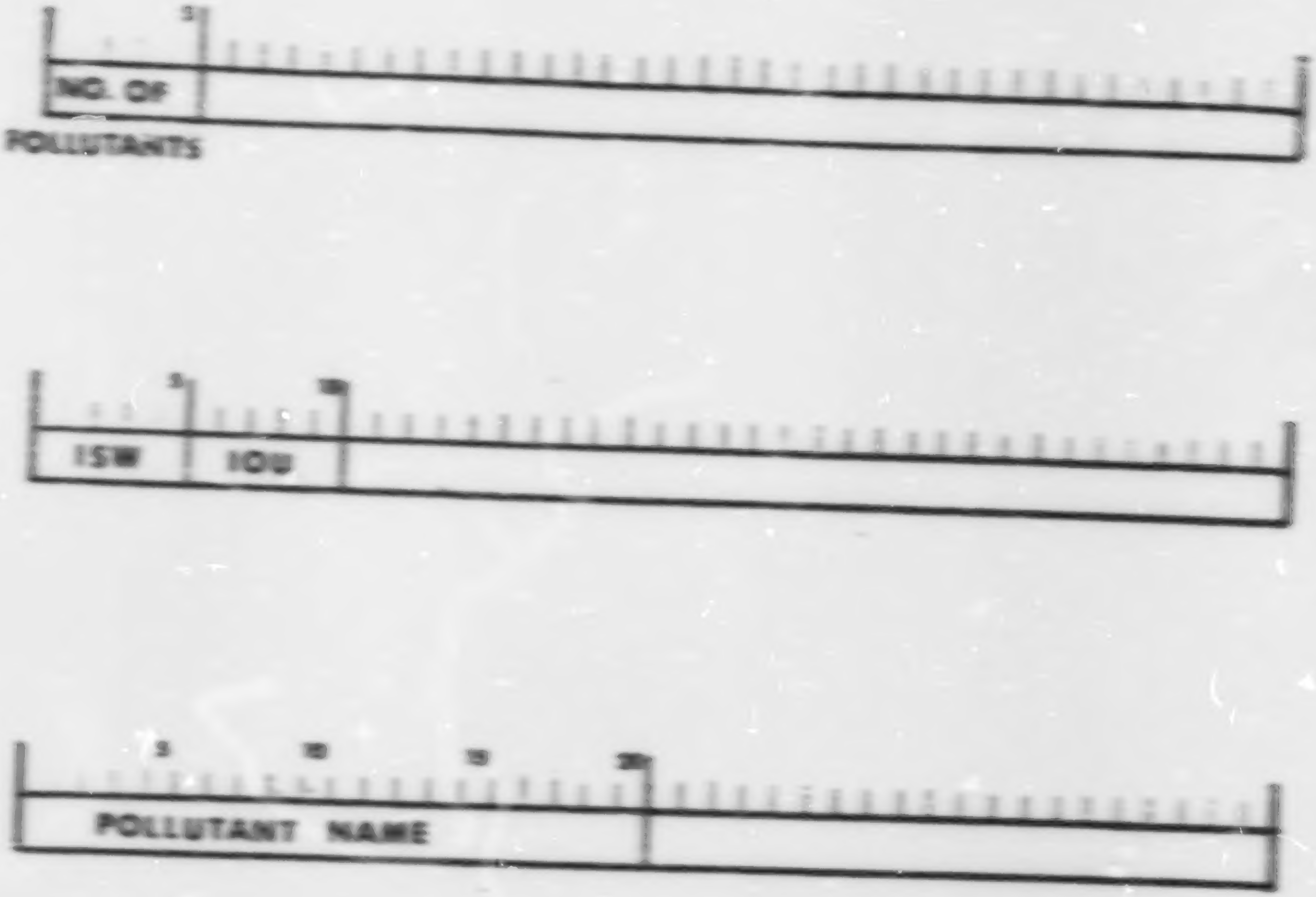
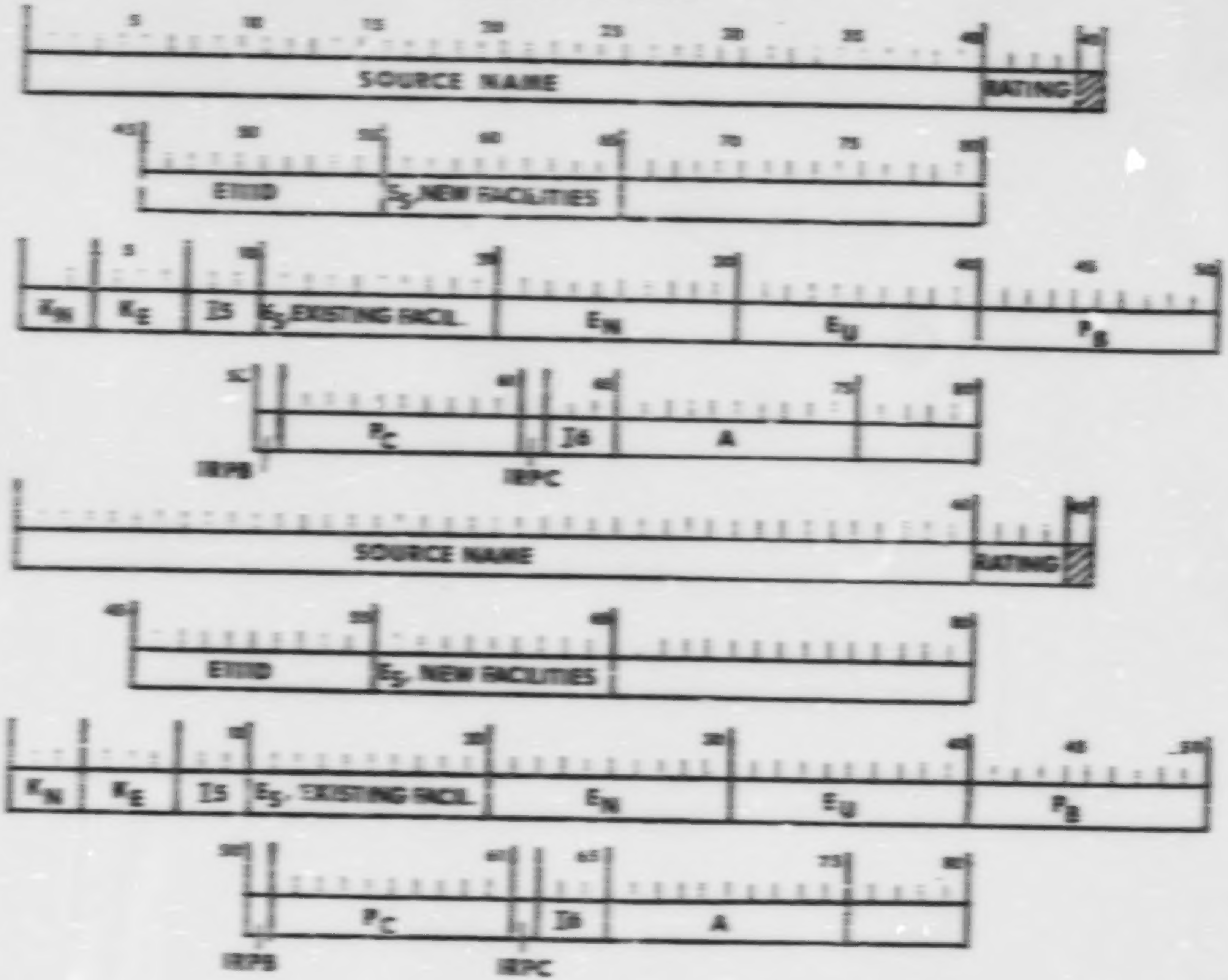

1
3
NO. OF
POLLUTANTS
5
10
ISW
IOU
5
10
15
20
POLLUTANT NAME

FIGURE 3-2 (Continued)



5
10
15
20
25
30
35
40
SOURCE NAME
RATING
45
50
55
60
65
70
75
80
EIIID
E_S, NEW FACILITIES
K_N
K_E
I5
E_S, EXISTING FACIL.
E_N
E_U
P_B
P_C
I6
A
IRPB
IRPC
SOURCE NAME
RATING
EIIID
E_S, NEW FACILITIES
K_N
K_E
I5
E_S, EXISTING FACIL.
E_N
E_U
P_B
P_C
I6
A
IRPB
IRPC

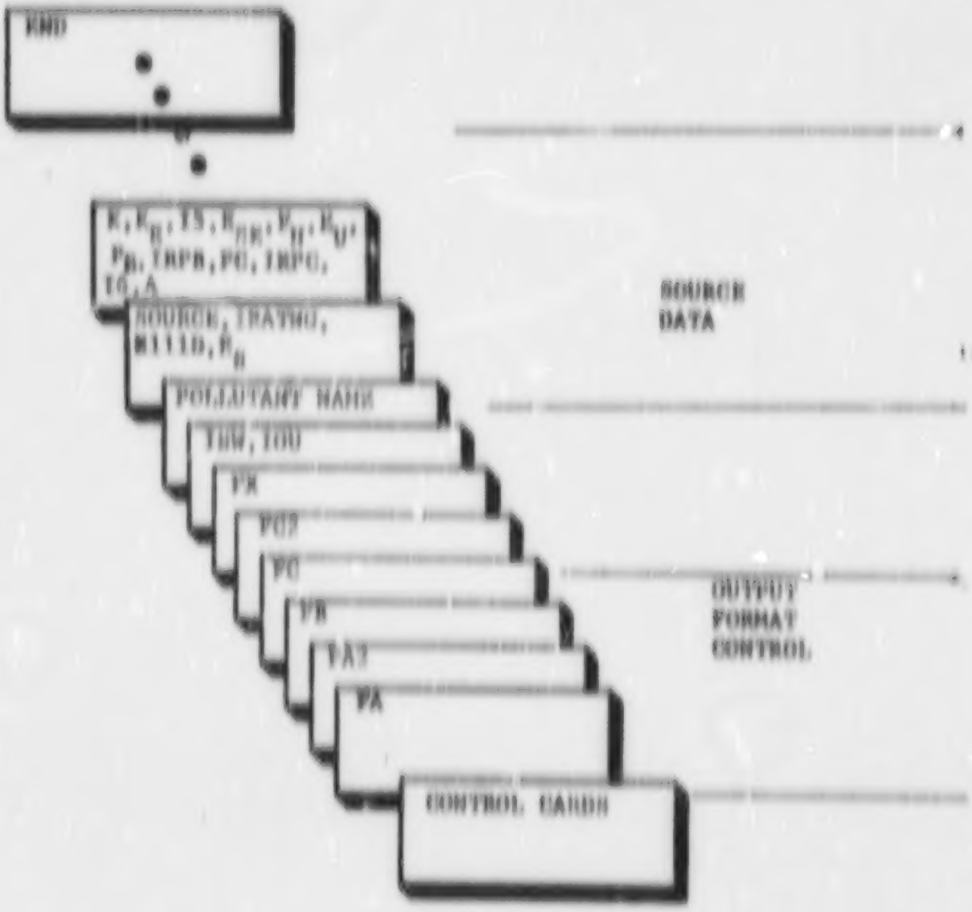

END
K, K_R, IS, K_SE, F_H, F_V,
F_B, IRPB, FC, IRPC,
IG, A
SOURCE, IRATIO,
KIIID, F_R
POLLUTANT NAME
TSW, IOU
FR
FC7
FC
FB
FA7
FA
CONTROL CARDS
SOURCE
DATA
OUTPUT
FORMAT
CONTROL

FIGURE 3-3
MODEL IV PROGRAM INPUT

TABLE 3-1

MODEL IV CODE VALUES
RANKING PARAMETERS, IRW & IOU

Order of Ranking

IRW + 1 Rank Output in Ascending Order

IRW = 0 Output Arranged in Order of Input

IRW - 1 Rank Output in Descending Order

Ranking Parameter

IOU	Rank By	IOU	Rank By
1	A	12	PC-B
2	B	13	E (existing)
3	C	14	TU
4	RH	15	TA
5	ES (existing)	16	TB
6	ES (new)	17	TUB
7	EU	18	TS
8	1 - RH/ES	19	THD
9	E11ID	20	$T_S - T_H; T_S - T_{HD}$
10	PB	21	TH
11	PC-C		

Source data are the last part of the data deck. Each source consists of a two card input. The first includes the source name, rating (not used in this project), E_{111D} (for designated pollutants only), and E_N for new facilities. For pollutants/sources which have identical E_E for new and existing facilities this value need not be punched. An asterisk (*) can be placed in Column 78 for those sources for which no demonstrated control technology is available. This figure will be printed on the output values page next to the source to distinguish it from those sources which have a demonstrated control technology. Asterisked sources, taken by themselves, are in fact also ranked according the preselected option. The second card provides the following data:

K_N = fractional utilization factor for new facilities.

K_E = fractional utilization factor for existing facilities, equal to K_N where no fractional utilization distinction is made between new and existing facilities.

IS = key for emissions units; i.e., pounds/ton, lb/10^6 BTU, etc. (see Table 3-2).

E_E = allowable emissions under existing regulations for existing facilities (mass/unit of capacity).

E_N = allowable emissions under standards of performance (mass/unit of capacity).

E_U = emissions with no control (mass/unit of capacity).

P_B = construction and modification rate to replace obsolete capacity (decimal fraction of baseline capacity/yr).

TABLE 3-2

MODEL IV CODE VALUES
EMISSIONS UNITS [15] & PRODUCTION UNITS [16]

Emission Units [15]

15	Emission Units
1	lb/gal
2	lb/E6 ft^3
3	lb/ton
4	lb/E6 BTU
5	lb/bale
6	lb/barrel
7	lb/yd^3
8	lb/production unit

Production Units [16]

16	Production Units
1	E6 gal
2	E6 ft^3
3	E6 tons
4	E12 BTU
5	E6 bale
6	E6 barrel
7	E6 yd^3
8	E6 production units

IRPR = S simple rate of replacement

= C compound rate of replacement

F_C = construction and modification rate to increase source capacity (decimal fraction of baseline capacity/yr).

IRPC = S simple rate of increase

= C compound rate of increase

I6 = key for units of production (production units/yr); see Table 3-2.

A = baseline year production capacity.

These source data cards are repeated for all sources of interest, limited by the storage capacity of the computer being used. In its present configuration the program will handle up to 110 sources.

3.3.3 Output

The Model IV output consists of a two page printout. The first page lists all the input variables and the intermediate variables, B and C. The output values for criteria pollutants, T_A, T_U, T_S, T_N, T_E, T_{UE}, (T_S-T_N) and (1-EN/ES) are listed on the second page. The printout for designated pollutants has the identical features as that for criteria pollutants except (T_S-T_N) is replaced by (T_S-T_{ND}) and $E_{111(d)}$ has been added.

As mentioned earlier, input or output values can be ranked in ascending, descending or as-input form by any one of 21 parameters chosen prior to data input. EPA-450/3-76-019-b and -019-c contain the results of our study ranked by these 21 options and presented on a pollutant basis. These two volumes are organized as follows:

Appendix	Title
EPA-450/3-76-019-b:	Ranked Data for Particulates
	Ranked Data for NO_x
	Ranked Data for SO^*
	Ranked Data for HC^*
EPA-450/3-76-019-c:	Ranked Data for CO
	Ranked Data for Fluorides
	Ranked Data for Hazardous Pollutants
	Ranked Data for Acid Mist
	Ranked Data for Lead
	Ranked Data for Ammonia
	Ranked Data for Sulfides
	Ranked Data for Chlorine
	Ranked Data for Trace Metals

The first five categories listed above (criteria pollutants) contain 19 subsections as outlined in Table 3-1 ($E_{111(d)}$ and T_{HD} are not applicable for criteria pollutants). The last eight categories (designated pollutants) contain all 21 subsections.

Another feature added to the output was the floating field for each variable and source. Because of the range of input variables, whose magnitudes are dependent upon the units used, it was most practical to customize the output for each variable according to its magnitude. All output values are rounded off as follows:

If the value is . . .	It is rounded to the nearest . . .
> 100	1.0
between 1 and 100	0.1
between 0.1 and 1.0	0.01
between 0.01 and 0.1	0.001
between 0.001 and 0.01	0.0001

This round off feature was added to offset the superficial accuracy of machine calculated values and to reflect the accuracy of the input variables.

3.4 Summary of Control Techniques

A great deal of informative and diverse information is available in the source calculation sheets which make up EPA-450/3-76-018-a through -018-f. Extracting certain details from these sheets could become time-consuming due to the sheer volume of material included. Many details, however, have already been summarized in EPA-450/3-76-017. Throughout the conduct of the program, there were several requests for specific details not heretofore presented. One such frequent request dealt with the control techniques deemed to be most applicable for each source category/pollutant. In an effort to respond to these requests and for the general information of those concerned with air pollution control from new stationary sources, Tables 3-3 to 3-13 at the end of Section 3 have been developed. They summarize the control techniques which represent the best control as applied to new plants, expected efficiency levels, the installation status as determined from the literature (new or retrofit), applicable literature references and appropriate comments. The numbers found under "Reference" in these tables are keyed to the bibliography in Appendix C, and represent the literature source(s) from which specific control information was determined. The following nomenclature was used to specify the installation status of control equipment as indicated in the column "New/Retrofit."

N_1 . . . New - Obvious from the literature
N_2 . . . New - Deduced from the literature
R_1 . . . Retrofit - Obvious from the literature

R_L . . . Retrofit - Deduced from the literature

I . . . Indeterminate

A . . . Control equipment assumed

The tables include the use of fabric filtration, scrubbing, cyclonic separation, electrostatic precipitation, thermal oxidation, catalytic oxidation, carbon adsorption, mechanical changes, process change and combustion modification.

3.5 Control Potential

Another question frequently asked is how much more stringent than existing state regulations would a given new source performance standard be. By relating E_S and E_N, we have developed an additional model factor, control potential (η) which yields values between 0.0 and 1.0. A value of zero would indicate that E_S is equal to E_N and that the anticipated new source standard is equal to the average of the existing state regulations for that source and pollutant. As the value of η approaches 1.0, the new source standard becomes more and more stringent than the existing state regulations such that, in the ultimate case (η = 1.0), there are no emissions from the source (E_N = 0.0). Control potential is defined as:

$$\eta = 1.0 - \frac{E_N}{E_S} \quad . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \quad (15)$$

The computer program has been updated to make this determination and a ranking option exists for presenting the output on the basis of η. Such rankings are presented in EPA-450/3-76-019-b and EPA-450/3-76-019-c for each pollutant.

3.6 Summary of Retirement Ages

Other frequent requests have dealt in one form or another with certain of the industrial factors--capacity, growth and obsolescence rates and their impact on nationwide emissions. The following Table 3-14 summarizes the estimated retirement ages of facilities evaluated in the study. The value, in years, is the reciprocal of F_B, in most cases, the rate at which obsolete capacity is replaced. This value, theoretically, would indicate when all capacity existing in the baseline year, 1975, will have been retired. Or, if new source standards were set in 1975, the value indicates the average number of years required for all capacity within the source category to be under the control of the standard. However, there were several cases where the reciprocal of F_B did not describe a realistic retirement age. For example, obsolescence rates for relatively new or emerging industries have yet to be determined. In order to evaluate these sources realistically, F_B was either zero or very small--the reciprocal being, therefore, infinite or absurdly large. In Table 3-14, these sources were specified "Indeterminate." There were certain other source categories which exhibited a zero growth rate. In order to evaluate emission impact, a F_B was determined; however, just how long it will be until the category is totally obsolete is pure conjecture. These sources have also been classified "Indeterminate." As described in detail in EPA-450/3-76-017, several source categories exhibited negative growth rates. Due to the probable lack of economic incentive, we assumed that these sources did not replace obsolete capacity and, as a result, set F_B equal to zero. These categories have been classed as "Decreasing Capacity." A few other sources were "Not

Evaluated" since odor was the only associated pollutant. Since these sources were not evaluated within Model IV, they were classified accordingly.

3.7 Future Emission Trends

For most source categories investigated the estimated trend of nationwide emissions under NSPS for the period 1975 to 1985 is downward. For those categories, this trend would continue presuming of course that K, P_C, P_B and E_B don't change. However, after all capacity existing in 1975 has been retired ($1/P_B$ years) the emission trend would then reverse itself eventually reaching and exceeding the 1975 levels. One could in theory determine when this would occur. Such estimates would indicate the length of time that a standard could maintain nationwide emissions below 1975 levels. Since the average retirement ages of the categories investigated were in the range of 20 to 40 years, any estimates of emission trends beyond that point, based on todays estimates of growth trends, capacity utilization or emission control levels would in all likelihood be incorrect. However, an estimate of the "lifespan" of a standard, as inaccurate as it may be, can serve to point up those source categories which might ultimately need a reevaluation. For certain categories, calculations show that hundreds of years can pass, all things remaining unchanged, before emissions reach 1975 levels. Such information can assist EPA in its long-term planning efforts for new source standards and for this reason, the following tables have been generated. For those cases exhibiting a downward emission trend, minimum annual emissions were determined for the first year in which all capacity would be subject to NSPS control (T_{MIN}). We then determined how many years would pass before emissions reached 1975 levels (R). The term Y_{TA} in the tables represents the calendar year in which this situation would ultimately occur. Such analyses were done for each applicable source category and the results are presented in Tables 3-15 through 3-27 on a pollutant by pollutant basis.

There were several instances where such estimates could not, for one reason or another, be determined. The tables reflect this as outlined below:

Situation	Table Designation
Unrealistic Retirement Age	Indeterminate Obsolescence Rate
$F_G < 0$	Decreasing Capacity
$F_G = 0$	Indeterminate - No Growth Category
$E_N = E$	Indeterminate - No Demonstrated Control Technology
$E_N = 0$	Indeterminate - Zero Emissions From NSPS Controlled Capacity

A substantial volume of information is presented in Tables 6-1 through 6-22 in EPA-450/3-76-017 and in nearly 2000 pages of calculation sheets published as EPA-450/3-76-018-a through -018-f. Any investigator could, in the future, use this information to analyze a variety of special case considerations depending on his specific requirements and the end use of his analyses. Any effort to further correlate the results beyond what is presented in these three volumes is deemed outside the scope of this present project.

TABLE 3-3

SUMMARY OF CONTROL TECHNIQUES
Fabric Filtration

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Carbon black	Furnace Process	Particulate	99.3	73,48	[illegible]	
[illegible]		Lead	99.8	276	[illegible]	
[illegible]		Particulate	99.0	129	[illegible]	In possible combination with cyclone
[illegible]		Particulate	99.0	75	[illegible]	
[illegible]		Particulate	81.0	33,75,129	[illegible]	
Detergent		Particulate	99.5	50	[illegible]	
[illegible]	[illegible]	Particulate	99.5	50	[illegible]	Transfer of Technology from Detergent Industry
Fertilizer	Granulated super triple phosphate storage	Particulate, Fluoride	Particulate: 99.3 Fluoride: 57.8	33,75	[illegible]	
Pesticides		Hazardous pollutants	99.2	269	[illegible]	
Animal feed de-fluorination		Particulate	99.99	43,192	[illegible]	Transfer of Technology from Lime Industry
Corn Processing		Particulate	97.0	22	[illegible]	
Feed milling	Alfalfa dehydrating	Particulate	99.5	30	[illegible]	
Feed milling	Other than alfalfa	Particulate	99.5	30	[illegible]	
Grain handling and processing	Handling	Particulate	96.0	1	[illegible]	
Grain handling and processing	Cleaning	Particulate	99.0	1	[illegible]	
Grain handling and processing	Processing	Particulate	96.0	1,25	[illegible]	Transfer of Technology from Grain Handling
[illegible]		Particulate	91.0	22	[illegible]	
Portland cement		Particulate	99.85	17,38	[illegible]	Preceded by cyclone
Sand and gravel		Particulate	95.0	46	[illegible]	

(continued)

TABLE 3-[illegible]
(continued)

SUMMARY OF CONTROL TECHNIQUES
Fabric Filtration

Source Category	Sub Category	Pollutant	Efficiency	Reference	Test Results	Comments
Stone quarrying, processing		Particulate	[illegible]	73	[illegible]	
[illegible]		Particulate, lead	Particulate: [illegible] Lead: [illegible]	[illegible]	A	Could also include H_2O sprays, hooding, cyclones, and wet scrubbers
Brick and related clay products		Particulate	[illegible]	28	[illegible]	Preceded by cyclone
Ceramic clay		Particulate	[illegible]	28	A	Preceded by cyclone; Transfer of Technology from Brick and Clay Manufacturing
Clay sintering		Particulate	[illegible]	226	A	Transfer of Technology from Fly Ash Sintering
Fly ash sintering		Particulate	[illegible]	226	[illegible]	Efficiency assumed
Frit manufacturing		Particulate, trace metals	[illegible]	45	I	
Glass manufacturing	Soda Lime Glass	Particulate	[illegible]	28	[illegible]	Application of control devices is just developing
Glass manufacturing	Opal glass	Particulate	[illegible]	28	[illegible]	Application of control devices is just developing
Gypsum		Particulate	[illegible]	75	[illegible]	
Lime		Particulate, SO_x	Particulate: [illegible] SO_x: [illegible]	[illegible]	I	
Mineral wool		Particulate	[illegible]	49	I	For control of [illegible] emissions
Perlite		Particulate	[illegible]	75	[illegible]	
Primary lead		Particulate, lead	Particulate: [illegible] Lead: [illegible]	28	A	
Primary zinc		Particulate	[illegible]	75	[illegible]	Electrostatic precipitators also used

(continued)

TABLE 3-3
(continued)

SUMMARY OF CONTROL TECHNIQUES
Fabric Filtration

Source Category	Sub-Category	Pollutant	Efficiency	Reference	[illegible]	Comments
Secondary aluminum	Sweat furnace	Particulate	96	49	I	
Secondary brass and bronze		Particulate, trace metals, lead	Particulate: 99.6 Trace Metals: 99.6 Lead: 99.6	75 46,75 46,75	[illegible]	
Cast iron foundry	Electric arc furnace	Particulate	99.8	50	I	
Secondary copper	Material handling	Particulate	99.6	49	I	
Secondary copper	Smelting and refining	Particulate	99.6	49	I	
Secondary lead	Blast furnace	Particulate, lead	Particulate: 97.0 Lead: 97.0	46	[illegible]	High energy scrubber also used; fabric filter usually preceded by afterburner
Secondary lead	Pot furnace	Particulate, lead	Particulate: 97.0 Lead: 97.0	46	[illegible]	High energy scrubber also used
Secondary lead	Reverb furnace	Particulate, lead	Particulate: 97.0 Lead: 97.0	46	[illegible]	High energy scrubber also used
Secondary magnesium		Particulate	97.0	46	A	Transfer of technology from Secondary Lead
Steel foundry		Particulate	99.0	222	I	
Secondary zinc	Distillation	Particulate	96.3	49	I	
Secondary zinc	Sweating	Particulate	96.3	49	A	Transfer of technology from Secondary Zinc Distillation Furnaces
Lead acid battery		Particulate	99.3	39	[illegible]	

(continued)

TABLE 3-3
(continued)

SUMMARY OF CONTROL TECHNIQUES
Fabric Filtration

Source Category	Sub Category	Pollutant	Efficiency	Reference	Test/Rationale	Comments
Wood processing	Plywood veneer	Particulate	99.7	47	A	
Wood waste boilers		Particulate	94.0	226	B_2	Efficiency assumed
Incinerators	Industrial/ commercial	Particulate	99.0	75	B_1	
Combustion of waste crank-case oil		Particulate	99.0	277	B_2	

TABLE 3-4

SUMMARY OF CONTROL TECHNIQUES
Scrubbing

Source Category	Sub Category	Pollutant	Efficiency	Reference	Eval/ Retrofit	Comments
Hydrochloric acid	By-product	Acid mist	94.7	242	B_2	
Hydrochloric acid	Salt	Acid mist	96.7	242	A	Transfer of Technology from By-product Hydrochloric Acid production
Phosphoric acid	Thermal process	Particulate	99.3	245	B_2	Venturi scrubber and cyclone
Chlor-alkali	Diaphragm cell	Chlorine	99.99	75,32	B_2	Caustic or lime
Chlor-alkali	Mercury cell	Chlorine	99.49	75,32	A	Caustic or lime; Transfer of Technology from Chlor-alkali Diaphragm cell
Explosives	High	Particulate	97.3	46	A	High energy; Transfer of Technology from Sewage Sludge Incineration
Explosives	High	SO_x	92.8	267	A	Sodium bisulfite process; Transfer of Technology from Sulfuric Acid Manufacturing
Explosives	High	NO_x	95.8	221	B_2	Bubble cap
Explosives	Low	SO_x	92.8	267	A	Sodium bisulfite process; Transfer of Technology from Sulfuric Acid Manufacturing
Phthalic anhydride	Benzene oxidation	Hydrocarbons, carbon monoxide	Hydrocarbons: 99.3 Carbon Monoxide: 96.9	139	B_2	Product recovery scrubber preceded by a combustion device
Soap manufacturing		Particulate	99.8	77	C	
Synthetic resins	Acrylic	Hydrocarbons	95.0	272	B_2	Nonregenerative, closed liquid systems, and conservation vent also used
Styrene-butadiene rubber		Hydrocarbons	25.2	129,31	B_2	Efficiency based on Dryer, Recovery and Fugitive Emissions Controls

(continued)

TABLE 3-4
(continued)

SUMMARY OF CONTROL TECHNIQUES
Scrubbing

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Adipic acid [illegible]		NO_x	97.0	270	[illegible]	Caustic
	Nitric acid oxidation	NO_x	98.0	109	A	Caustic; Transfer of Technology from Adipic Acid, Nitric Acid Tail Gas Processes
Hydrofluoric		Particulate, Fluoride	Particulate: 92.0 Fluoride: 99.6	75	A	
Phosphoric acid		Fluoride	99.6	238,234	R	
Fertilizer	Ammonium sulfate	Particulate	Particulate: 97.0	48,40	R	
Fertilizer	Diammonium phosphate	Particulate, NH_3, Fluoride	Particulate: 98.0 NH_3: 99.0 Fluoride: 79.4	75,77,238	R	
Fertilizer	Granulated triple super phosphate production	Fluoride	81.0	33	I	
Fertilizer	Nitrate	Particulate, NH_3	Particulate: 98.0 NH_3: 98.0	48,122	I	Scrubber with filter system
Fertilizer	WPP-triple super phosphate	Fluoride	80.0	33,238	I	Venturi and spray cross-flow packed bed scrubber
Fertilizer	Super phosphoric acid vacuum evaporation	Fluoride	81.5	77	I	Wet scrubber
Fertilizer	Super phosphoric acid Submerged Combustion	Fluoride, Acid Mist	Fluoride: 99.94 Acid Mist: 95.4	48,238	R	Spray Cross-flow packed bed Scrubber
Animal feed defluorination		Fluoride	94.8	50	R	Packed scrubber

(continued)

TABLE 3-4
(continued)

SUMMARY OF CONTROL TECHNIQUES
Scrubbing

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Direct firing of meats		Hydrocarbons	57.0	254	R_2	Oscillator scrubber
Fish meal processing		H_2S	99.0	38,75	R_1	Chlorinating scrubber system
Smoked meat		Particulate, carbon monoxide, hydrocarbons	Particulate: 96.7 Carbon Monoxide: 100.0 Hydrocarbons: 57.1	75	R_1	Wet scrubber in series with low voltage precipitator
Starch		Particulate	97.75	75	R_1	Centrifugal gas scrubber
Sugar cane processing	Bagasse burning	Particulate	90.0	3	A	Cyclone wet scrubber preceded by a multicyclone
Asphalt batching		Particulate	99.9	75	R_1	Orifice type
Brick and related clay products		SO_x, fluoride	SO_x: 40.0 Fluorides: 70.0	18	I	Medium energy
Castable refractories		Particulate, fluoride	Particulate: 96.3 Fluorides: 95.0	25,75	R_1	Venturi scrubber in series with a cyclone
Ceramic clay		Acid mist	96.7	167,217	A	Transfer of Technology from Hydrochloric Acid Production
Coal cleaning		Particulate	99.5	75	R_1	Followed by cyclone
Fiberglass	Wool processing	Particulate	91.0	228	R_1	Must also change process conditions and use a baffled penthouse
Fiberglass	Textile processing	Particulate	98.3	229	A	Must also change process and use a baffled penthouse; Transfer of Technology from Wool Processing

(continued)

TABLE 3-4
(continued)

SUMMARY OF CONTROL TECHNIQUES
Scrubbing

Source Category	Sub Category	Pollutant	Efficiency	Reference	Test/ Retrofit	Comments
Frit manufacturing		Fluoride	94.0	75	R_1	High ΔP venturi scrubber
Glass manufacturing	Opal glass	Fluoride	80.0	234	I	
Phosphate rock	Calcining	Particulate	99.0	47	A	
Primary aluminum		Particulate	98.0	35	R_2	Fluid bed dry scrubber; coated filter dry scrubber or injected alumina dry scrubber
Primary aluminum		Fluoride	95.7	161	R_1	Dry-scrubber – baghouse combination
Primary copper		SO_x	98.5	30	R_2	Lime-slurry scrubber or sulfuric acid recovery
Ferroalloy		Particulate	95.0	220	R_2	Venturi scrubber
Iron and steel	Electric arc furnace	Fluoride	93.6	75	R_1	Venturi scrubber
Iron and steel	Open hearth furnace	Particulate, trace metals fluoride	Particulate: 95.0 Trace Metals: 95.0 Fluorides: 95.0	234	I	Venturi scrubber or electrostatic precipitator with all HF converted to solid
Primary lead		SO_x	98.5	30	R_2	Scrubbing done along with recirculating sinter machine
Secondary aluminum	Reverb furnace	Particulate, acid mist	Particulate: 95.5 Acid Mist: 97.9	132	I	Wet (fluid bed) scrubber
Secondary lead	Blast furnace	SO_x	94.0	75	R_1	NaOH Scrubber
Secondary lead	Reverb furnace	SO_x	94.0	75	A	NaOH Scrubber; Transfer of Technology from Secondary Lead Blast Furnaces
Can manufacturing (soldering of can)		Lead	75.0	276	I	Low energy

(continued)

TABLE 7-4
(continued)

SUMMARY OF CONTROL TECHNIQUES
Scrubbing

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Petroleum industry: process gas production		SO_x	91.0	44	N,R	Amine scrubbing
Boilers	>250x10^6 BTU/hr	SO_x Particulate	SO_x: 94.0 Particulate: 98.4	22,73	N,R	Alkaline scrubbing
Boilers	Mixed fuel	SO_x Particulate	SO_x: 80.0 Particulate: 99.0	269	N,R	Alkaline scrubbing
Incinerators	Municipal	HCl,Particulate	HCl: 95.0 Particulate: 95.0	85	N,R	Could also use ESP or baghouse
Incinerators	Pathological	Particulate, trace metals	Particulate: 85.0 Trace Metals: 85.0	—	N	
Incinerators	Sludge	Particulate, trace metals	Particulate: 98.9 Trace Metals: 98.9	44,271	N,R	

TABLE 3-5

SUMMARY OF CONTROL TECHNIQUES
Cyclonic Separation

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Cotton Ginning		Particulate, Arsenic	Particulate: 96.0 Arsenic: 96.0	11	N_1	Small Diameter
Fertilizer	Normal Super-Phosphate	Fluoride	99.25	236	I	Two Stage Cyclonic Scrubber
Coffee Roasting		Particulate	94.0	6	N_2	Preceded by Afterburner
Fishmeal Processing		Particulate	90.0	50	I	
Vegetable Oil Manufacturing		Particulate	85.0	267	A	
Phosphate Rock	Drying	Particulate	90.0	75	R_1	Dry Cyclone Followed by Wet Scrubber
Phosphate Rock	Grinding	Particulate	99.5	75	R_1	

TABLE 3-4

SUMMARY OF CONTROL TECHNIQUES
Electrostatic Precipitation

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Sulfuric Acid		Acid Mist	95.7	75	R_1	Or Fiber Mist Eliminator
Synthetic Fibers	Dacron	Particulate	95.3	75	R_1	
Synthetic Fibers	Nylon	Particulate	95.0	75	R_1	
Synthetic Resins	Polyester	Particulate	95.0	75	R_1	
Direct Firing of Meats		Particulate	92.6	255	R_2	
Primary Copper		Particulate	99.7	75	R_1	
Iron & Steel	Blast Furnace	Particulate, Trace Metals	Particulate: 99.0 Trace Metals: 99.0	75	R_1	Venturi or ESP with Wet Scrubber & Primary Cyclone or Settling Chamber
Iron & Steel	Basic Oxygen Furnace	Particulate, Trace Metals, Fluoride	Particulate: 99.7 Trace Metals: 99.7 Fluorides: 99.7	83	R_1	Venturi Scrubber Can Also be Used
Iron & Steel	Sintering	Particulate	99.6	75	R_1	Used with Cyclone; Cyclone and Wet Scrubber May Also be Used
Iron & Steel	Scarfing	Particulate	99.0	47	A	Used with Settling Chamber; Settling Chamber & High Energy Scrubber May Also be Used
MSIS		Particulate, Trace Metals	Particulate: 96.0 Trace Metals: 96.0	46	R_2	
T.I.S & MSIS		Particulate, Trace Metals	Particulate: 96.0 Trace Metals: 93.0	46	A	Transfer of Technology from MSIS
Boilers	Mixed Fuel	Particulate	99.2	249	R_1	
Boilers	> 250 × 10^6 BTU/hr	Particulate	98.4	22,73	R_1	Could Also Use Scrubbers
Kraft Pulping	Kraft Process (Sulfate)	Particulate	97.2	197	I	Used with Venturi Scrubber

TABLE 3-7

SUMMARY OF CONTROL TECHNIQUES
Thermal Oxidation

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/Retrofit	Comments
Acrylonitrile		HC, CO	Hydrocarbons: 99.95 Carbon Monoxide: 99.95	50	I	
Ammonia	Regenerator & CO Absorber Plant	CO, NH_3, HC	Carbon Monoxide: 99.5 Hydrocarbon: 99.5 NH_3: 99.[illegible]	75	R_1	Preceded by Two-Stage Water Scrubber
Ammonia	Methanator	HC, NH_3	NH_3: 99.0	75	R_1	
Carbon Black	Furnace Process	CO, HC	Carbon Monoxide: 99.8 Hydrocarbon: 99.8	50	I	Thermal or Catalytic
Ethylene Dichloride	Oxychlorination Process	CO, HC	Carbon Monoxide: 99.8 Hydrocarbon: 99.8	50	I	Preceded by Wet Scrubber
Formaldehyde		CO, HC	Carbon Monoxide: 99.8 Hydrocarbon: 99.8	50	I	
Phthalic Anhydride	O-Xylene	CO, HC	Carbon Monoxide: 99.8 Hydrocarbon: 96.2	50	I	
Polyethylene	High Density	HC	98.0	36	I	
Polyethylene	Low Density	HC	92.0	36	I	
Polystyrene		HC	99.0	129	A	Transfer of Technology from Polypropylene Industry
Polyvinyl Chloride		HC	99.5	129	A	Or Waste Gas Collection; Transfer of Technology from Polypropylene Industry
Synthetic Resins	Phenolic	HC	99.2	129	A	Transfer of Technology from Polypropylene Industry
Synthetic Resins	Urea Melamine	HC	99.0	129	A	Transfer of Technology from Polypropylene Industry
Synthetic Resins	ABS-SAN	HC	99.2	129	A	Transfer of Technology from Polypropylene Industry
Synthetic Resins	Alkyd	HC	99.2	272	I	Vent Gas Combustion
Varnish		HC	99.8	50	I	
Fuel Conversion—Coal Gasification	High BTU	Sulfides	57.2	256	I	
Polypropylene		HC	99.5	129	R_1	

(continued)

TABLE 3-7
(continued)

SUMMARY OF CONTROL TECHNIQUES
Thermal Oxidation

Source Category	Sub Category	Pollutant	Efficiency	Reference	Use/ [illegible]	Comments
Fuel Conversion Coal Gasification	Low BTU	Sulfides	97.0	256	I	
Meat Processing		HC	90.0	12,75	A	
Deep Fat Frying		Particulate, HC	90.0	24	A	
Ferroalloy		CO	99.0	238	A	
Iron & Steel	Basic Oxygen Furnace	CO	97.0	75	B_1	Combustion in the Hood, Direct Flaring or Other Ignition Means
Secondary Smelter		CO, HC	Carbon Monoxide: 99.0 Hydrocarbon: 90.0	75	A	
Lead Acid Battery		HC	90.0	39	A	Carbon Adsorption May Also Be Used
Wood Processing	Plywood Veneer	HC	90.0	170,240	A	
Petroleum Refinery	Vacuum Distillation	HC	90.0	75	B_1	Fume Burner
Graphic Arts	Flexography	HC	90.0	30	I	
Graphic Arts	Lithography	HC	90.0	30	I	
Graphic Arts	Letter Press	HC	90.0	30	I	
Graphic Arts	Metal Decorating	HC	90.0	30	I	
Charcoal		Particulate, HC, CO	Particulate: 90.0 Hydrocarbon: 90.0 Carbon Monoxide: 90.0	75	B_1	
Printing Ink		HC	90.0	75	B_1	Preceded by Scrubber or Condenser
Asphalt Roofing	Blowing	Particulate, HC, CO	Particulate: 90.0 Hydrocarbon: 90.0 Carbon Monoxide: 90.0	21	I	
Asphalt Roofing	Saturator	Particulate	90.0	21	I	
Mineral Wool		HC	57.0	—	A	Direct-Flame Type

(continued)

TABLE 3-2
(continued)

SUMMARY OF CONTROL TECHNIQUES
Thermal Oxidation

Source Category	Sub Category	Pollutant	Efficiency	Reference	Data Reliability	Comments
Cast Iron Foundry	Core Ovens	HC	87.0	46	I	Modification of Core Oil Mixture May Also Be Used
Industrial Surface Coating		HC	97.3	50,75	I	Activated Carbon, Reformulation & Electrocoating Techniques Etc. - Also Be Used
Incinerators	Autobody	HC, CO	Hydrocarbons: 74.0 Carbon Monoxide: 107.0	38	B₁	Afterburner
Incinerators	Pathological	HC, CO	Hydrocarbons: 99.0 Carbon Monoxide: 99.0	39	A	Afterburner

TABLE 7-8

SUMMARY OF CONTROL TECHNIQUES
Catalytic Reduction

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Nitric Acid		NO_x	99.2	73	N_1	
Ethylene Oxide		HC	98.5	32	I	
Explosives	Low	NO_x	97.0	147	A	Catalytic Decomposition; Transfer of Technology from Nitric Acid Manufacturing
Wood Pulping	Kraft Process (Sulfate)	Sulfide, NO_x	NO_x: 68.0	187	I	Full Control of Process Includes:
			Sulfide: 99.1	73,187	N_1	1) High efficiency black liquor oxidation 2) Non-condensible gas burning 3) Stripping & burning off gas from condensate 4) High efficiency electrostatic precipitators & wet scrubber on recovery furnace 5) Venturi scrubber on lime kiln 6) Demister with smelt dissolver tank

TABLE 3-9

SUMMARY OF CONTROL TECHNIQUES
Carbon Adsorption

Source Category	Sub Category	Pollutant	Efficiency	Reference	[illegible]	Comments
Synthetic Fibers	Acetate	HC	[illegible]	75	A	Transfer of Technology from Nylon Production
Synthetic Fibers	Nylon	HC	[illegible]	75	A	
Synthetic Fibers	Viscose Rayon	Sulfides	[illegible]	75	B_1	
[illegible]		HC	[illegible]	112	A	
Pharmaceuticals		Hg	[illegible]	216	A	Iodine-Impregnated Carbon
Degreasing		HC	[illegible]	40	I	
Dry Cleaning		HC	[illegible]	58	I	Thermal Incineration May Also be Used
Graphic Arts	Gravure	HC	[illegible]	30	I	

TABLE 3-10

SUMMARY OF CONTROL TECHNOLOGY
[illegible]

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Chlor-Alkali	Mercury Cells	Mercury	99.99	52	A	Improved Housekeeping & Molecular Sieve; Transfer of Technology from Chlor-Alkali production with Diaphragm cells
Sodium Carbonate	Solvay Process	NH_3	50.0	75,85	A	Improved Design & Operating Procedures
Crude Oil & NG Production	Sulfur Recovery	SO_2	57.3	249	I	Improved Design & Operating Procedures
Grain Handling & Processing	Drying	Particulate	99.5	1	N	Sliding Bar Cleaning System with Settling Screens
Vegetable Oil Production		HC	64.7	2	N	Improved Design & Operating Conditions
Concrete Batching		Particulate	99.0	75	N	Improved Housekeeping Enclosure of Dumping & Loading Area Control Storage Bins with Water Spray
Beehive Coke Ovens		Particulate, NO_x, SO_x, HC, CO, Sulfides, Chlorine				Replace Ovens with Well-designed Slot-Type Ovens with By-Product Gas Recovery System; Efficiency not determined
By-Product Coke Ovens		Particulate, NO_x, SO_x, HC, CO, Sulfides	Particulate: 97.2		N	Good Operating & Maintenance Techniques
			NO_x: 0.0		N	
			SO_x: 1.2		N	
			Hydrocarbons: 97.0		N	
			Carbon Monoxide: 0.0		N	
			Sulfides: 50.0	50,259	I	

(continued)

TABLE 3-13
(continued)

SUMMARY OF CONTROL TECHNIQUES
Industrial Complex

Source Category	Sub Category	Pollutant	Efficiency	Reference	Test Intensity	Comments
Primary Zinc		SO_x	98.5	30	A	Use of Electrolytic Zinc Extraction Production Process
Wood Pulping	Kraft Process (Sulfate)	CO	97.8	102	B_1	Good Operating & Maintenance Techniques on Recovery Furnace & Lime Kiln
Petroleum Refinery	Miscellaneous Point Sources Control	HC	98.0	75	A	Good Housekeeping & Vapor Recovery
Incinerators		Particulate				Modified Burner Configuration; Efficiency not determined

TABLE 3-11

SUMMARY OF CONTROL TECHNIQUES
Process Change

Source Category	Sub Category	Pollutant	Efficiency	Reference	New/ Retrofit	Comments
Sulfuric Acid		SO_x	98.7	75	R,	Dual Stage Absorption Process Change
Asphalt Batching		SO_x	49.8	75,101	A	Fuel Switching to Lower % S Fuel
Automobile Assembly Plant		HC	90.0	50	I	Any combination of Electrostatic Spraying Powder Electrostatic Electrocoating Flowcoating
Wood Pulping	Sulfite	Particulate, SO_x	Particulate: 87.5 SO_x: 94.1	296	R, I	Magnefite Chemical Recovery Process
Wood Pulping	NSSC	SO_x	96.0	296	A	Magnefite Chemical Recovery Process; Emissions & Controls assumed to be the same as Wood Pulping-Sulfite Process
Refinery Fuel Gas	Sulfur Recovery	SO_x	98.5	159	R,	Claus Plant Sulfur Recovery plus Tail-Gas Process
Coal Cleaning		SO_x	73.0	291	A	Reduce Sulfur Content of Coal
Boilers	(0.3 - 10) x 10^6 BTU/hr	SO_x, Particulate, NO_x, Fluorides, Trace Metals	Particulate: 88.0 NO_x: 4.0 SO_x: 71.1 Fluorides: 73.1 Trace Metals: 80.0	22,73	R,	Reduce Sulfur Content of Fuel Combined with Fuel Additive and Combustion Modifications
Boilers	(10 - 250) x 10^6 BTU/HR	SO_x, Particulate, F_x, Fluorides, Trace Metals	Particulate: 91.7 NO_x: 46.0 SO_x: 85.0	22,73	R,	Reduce Sulfur content of fuel combined with fuel additive and combustion Modifications

(continued)

TABLE 3-11
(continued)

SUMMARY OF CONTROL TECHNIQUES
Process Change

Source Category	Sub Category	Pollutant	Efficiency	Reference	Cost/ Rationale	Comments
Internal Combustion	Dual Fuel	SO_x, Particulate, Hydrocarbons	Fluorides: 95.3 Trace Metals: 93.5 Particulates: 14.9 NO_x -11.8 Hydrocarbons: 3.2	—	B_1	Reduce Sulfur Content of Fuel (Natural Gas); Assumed control efficiency of fuel switching
Gas Turbine Engines	Electric Utility; Gas Pipeline	SO_x	17.8	32,75	B_1	Reduce Sulfur Content of Fuel

TABLE 7-12

SUMMARY OF CONTROL TECHNIQUES

Combustion Modification

Source Category	Sub Category	Pollutant	Efficiency	Reference	Data Reliability	Comments
Petroleum Refinery	Process Gas Combustion	NO_x	32.7	242	I	Optimum Design of Boiler
Gas Turbine Engines	Gas Pipeline; Electric Utility	NO_x, CO	NO_x 65.7 CO 67.4	32,75	R	Water Injection
Internal Combustion Engines	Spark Ignition	NO_x	43.5	58	I	Combustion Modifications Plus Water Injection
Internal Combustion Engines	Diesel and Dual Fuel	NO_x	31.1	58	I	Combustion Modifications Plus Water Injection
Boilers	Mixed Fuel	NO_x	62.3	209	I	
Incineration	Technological	NO_x	20.0	—	A	Efficiency Assumed

TABLE 3-13

SUMMARY OF CONTROL TECHNIQUES
Miscellaneous Controls

Source Category	Sub Category	Pollutant	Efficiency	Reference	Year Available	Comments
Iron & Steel	Electric Arc Furnace	Particulate, Trace Metals, CO	Particulate: 94.3 Carbon Monoxide: 71.9 Trace Metals: 94.3	239	C_1 C_1	Direct Shell Evacuation and Building Evacuation or Canopy Hoods, Closed Roof
Petroleum	Tank Storage	HC	43.0–90.0	37	B_1	Floating Roof; Efficiency is dependent on the vapor pressure of the fluid
Petroleum	Transfer	HC	43.0–90.0	37	B_1	Floating Roof; Efficiency is dependent on the vapor pressure of the fluid
Petroleum	Refueling	HC	85.0	36	B_1	Gasoline Adsorption
Petroleum	Service Station	HC	90.1	75	B_1	Vapor Return System
Portland Cement		SO_x, NO_x	SO_x-58.3 NO_x-15.0	75,201 75	A C_1	Lower Heat Requirements of Process to Reduce Quantity of Fuel Used
Textile Manufacturing		HC	85.4	229	I	Restrictions on Finishing Operations
Open Burning	Agricultural	Particulate, SO_x, HC, CO	100.0	—	A	Assumed control strategy of prohibition

TABLE 3-14

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
I. STATIONARY COMBUSTION SOURCES	
BOILERS, FOSSIL FUEL	
<0.3 x 10^6 BTU/hr	30
0.3-10 x 10^6 BTU/hr	27
10-250 x 10^6 BTU/hr	20
>250 x 10^6 BTU/hr	20
Mixed Fuel	
Coal & Refuse	Indeterminate
Oil & Refuse	Indeterminate
Wood Waste	20
ENGINES, STATIONARY	
Gas Turbines	
Electric Utility	30
Pipe Line	50
Internal Combustion	
Spark Ignition (Heavy Duty Gas Fired)	30
Diesel and Dual Fuel	30
INCINERATORS	
Auto Body	26
Conical	Decreasing Capacity
Industrial/Commercial	26
Municipal	26
Pathological	26
Sludge	30
MISCELLANEOUS COMBUSTION	
Open Burning	
Commercial/Industrial	Indeterminate
Agricultural	
Orchard Heaters	30
Combustion of Waste Crankcase Oil	Indeterminate
II. CHEMICAL PROCESS INDUSTRY	
ACIDS	
Adipic	67
DMT/TPA (Nitric Acid Oxidation)	22

(continued)

TABLE 3-14
(continued)

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
Hydrochloric	
By-product	22
Salt	22
Hydrofluoric	22
Nitric	20
Phosphoric	
Wet Process	22
Thermal Process	22
Sulfuric	22
ACRYLONITRILE	22
AMMONIA	
Methanator Plant	22
Regenerator & CO-Absorber Plant	22
CARBON BLACK	
Channel Process	Decreasing Capacity
Furnace Process	22
CHARCOAL	22
CHLOR-ALKALI	
Diaphragm Cells	22
Mercury Cells	22
CRUDE OIL & NG PRODUCTION - SULFUR RECOVERY	29
DETERGENT	Indeterminate
ESSENTIAL OILS	Not Evaluated
ETHYLENE DICHLORIDE (OXYCHLORINATION PROCESS)	22
ETHYLENE OXIDE	22
EXPLOSIVES	
High	22
Low	22
FORMALDEHYDE	22

(continued)

TABLE 3-14
(continued)

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
FUEL CONVERSION - COAL GASIFICATION	
High BTU Gas	Indeterminate
Low BTU Gas	Indeterminate
LEAD PIGMENT	Decreasing Capacity
MALEIC ANHYDRIDE (BENZENE OXIDATION)	22
PAINT	15
PHTHALIC ANHYDRIDE	
Naphthalene	Decreasing Capacity
O-xylene	50
PRINTING INK	22
SOAP	22
SODIUM CARBONATE	
Solvay Process	Decreasing Capacity
Natural	22
SYNTHETICS	
Fibers	
Acetate	22
Dacron	22
Nylon	22
Viscose Rayon	22
Polyethylene	
High Density	Indeterminate
Low Density	Indeterminate
Polypropylene	Indeterminate
Polystyrene	Indeterminate
Polyvinyl Chloride	Indeterminate
Resins	
ABS-SAN	Indeterminate
Acrylic	22
Alkyd	22
Phenolic	Indeterminate
Polyester	22

(continued)

TABLE 3-14
(continued)

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
Urea Melamine	Indeterminate
SBR Rubber	Indeterminate
VARNISH	15
III. FOOD AND AGRICULTURAL INDUSTRY	
AGRICULTURAL	
Cotton Ginning	24
Fertilizer:	
Ammonium Sulfate	22
Diammonium Phosphate	22
Granulated Triple Superphosphate	
Production	22
Storage	22
Nitrate	22
Normal Superphosphate	Decreasing Capacity
ROP Triple Superphosphate	Decreasing Capacity
Superphosphoric Acid	
Submerged Combustion	Decreasing Capacity
Vacuum Evaporation	22
Pesticides	22
FOOD	
Animal Feed Defluorination	25
Animal Husbandry	Not Evaluated
Beer Processing	25
Canneries	Not Evaluated
Castor Bean Processing	Decreasing Capacity
Coffee Roasting	25
Deep Fat Frying	36
Direct Firing of Meats	20
Feed Milling & Storage	
Alfalfa Dehydrating	35
Other	35
Fish Processing (Fish Meal Cookers & Driers)	Indeterminate
Grain Handling & Processing	
Transfer	27
Screening, Cleaning	27

(continued)

TABLE 3-15
(continued)

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
Drying	27
Processing	27
Meat Packing	Not Evaluated
Meat Smoke Houses	25
Poultry Processing	Not Evaluated
Rendering	Not Evaluated
Starch Manufacturing	22
Stockyards & Slaughterhouses	Not Evaluated
Sugar Cane Processing	
Bagasse Burning	20
Field Burning	Indeterminate
Vegetable Oil Manufacturing	30
Whiskey Processing	31
OTHER	
Pharmaceuticals	22
Tanneries	Not Evaluated
IV. MINERAL PRODUCTS INDUSTRY	
ASPHALT	
Batching	Indeterminate
Roofing	
Saturator	24
Blowing	24
CONCRETE	
Batching	30
Cement Plants (Kilns, Clinker Coolers)	40
MINING	
Sand and Gravel	20
Stone Quarrying & Processing	20
Lead Ore	20
PROCESSING	
Brick and Related Clay Products	30
Calcium Carbide	Decreasing Capacity

(continued)

TABLE 3-14
(continued)

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
Castable Refractory	30
Ceramic Clay	30
Clay and Flyash Sintering	
Clay	30
Flyash	30
Coal Cleaning (Thermal Drying)	20
Fiberglas	
Wool Processing	15
Textile Processing	15
Frit	30
Glass	
Soda Lime Glass	30
Opal Glass	30
Gypsum	Indeterminate
Lime	20
Mineral Wool	35
Perlite	35
Phosphate Rock	
Calcining	20
Drying	20
Grinding	20
V. METALLURGICAL INDUSTRY	
PRIMARY METALS	
Aluminum Smelters	29
Coke Ovens	
Bee-Hive Oven	Decreasing Capacity
By-Product Oven	36
Copper Smelters	38
Ferroalloy	36
Iron & Steel Plants	
Blast Furnace	35
BOF	36
Electric Arc Furnace	36
Open Hearth Furnace	Decreasing Capacity
Sintering	36
Scarfing	36
Lead Smelters	28
Zinc Smelters	28

(continued)

TABLE 3-14
(continued)

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
SECONDARY METALS	
Aluminum Production	
Sweat Furnace	28
Reverb Furnace	28
Brass & Bronze Smelting	28
Cast Iron Foundry	
Core Ovens	36
Cupola Furnace	Decreasing Capacity
Electric Furnace	36
Copper:	
Material Handling	29
Smelting & Refining	29
Lead Smelter	
Blast Furnace	42
Pot Furnace	42
Reverb Furnace	42
Magnesium Smelting	29
Steel Foundries	36
Zinc	
Distillation	29
Sweating	29
VI. EVAPORATION LOSS SOURCES	
DEGREASING	26
DRY CLEANING	20
GRAPHIC ARTS	
Gravure	22
Flexography	22
Lithography	22
Letterpress	22
Metal Decorating	22
PETROLEUM STORAGE & TRANSFER	
Bulk Transfer (Tank Cars, Trucks & Marine)	26
Refueling Motor Vehicles	53

(continued)

TABLE 3-16
(continued)

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
Service Stations	32
Tank Storage	33
INDUSTRIAL SURFACE COATING	24
TEXTILE PROCESSING	
Heat Setting/Finishing	26
Texturizing	26
Carpet Manufacturing	26
VII. PETROLEUM INDUSTRY	
FCCU	33
GASOLINE ADDITIVES	
Sodium Lead Alloy	Decreasing Capacity
Electrolytic	Decreasing Capacity
TEAD AND MEAD	Decreasing Capacity
PROCESS GAS COMBUSTION	33
VACUUM DISTILLATION	33
MISCELLANEOUS POINT SOURCES	33
REFINERY FUEL GAS - SULFUR RECOVERY	33
VIII. WOOD PRODUCTS INDUSTRY	
WOOD PROCESSING	
Particleboard	32
Plywood	20
WOOD PULPING	
Kraft Process (Sulfate)	33
Sulfite	33
NSSC	33

(continued)

TABLE 3-14
(continued)

SUMMARY OF RETIREMENT AGES

Source Category	Average Retirement Age (Yrs)
IX. ASSEMBLY PLANTS	
AUTOMOBILE	25
CABLE COVER PRODUCTION	Decreasing Capacity
CAN MANUFACTURING	Decreasing Capacity
LEAD ACID BATTERY	25
TYPE METAL PRODUCTION	Decreasing Capacity
X. WASTE DISPOSAL (NON-COMBUSTION)	
INDUSTRIAL WASTE HANDLING (LIQUIDS)	Not Evaluated
SEWAGE TREATMENT	Not Evaluated

TABLE 3-15

EMISSION TRENDS

PARTICULATES

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
PHOSPHATE ROCK - GRINDING	20	0.045	5453	7858
GLASS - OPAL	30	0.008	1905	3910
CLAY SINTERING	30	0.014	1860	3865
GLASS - SODALIME	30	0.507	1799	3804
COKE OVENS - BY PRODUCT	36	20.531	738	2749
GYPSUM	34	2.296	559	2564
ASPHALT SATURATOR	25	0.331	415	2419
SEC MAGNESIUM	29	0.007	363	2367
GRAIN HANDLING - PROCESSING	27	4.405	260	2262
PAINT MANUFACTURING	15	0.003	251	2241
VEGETABLE OIL PRODUCTION	36	3.726	220	2231
GRAIN HANDLING - SCREENING	27	8.810	194	2196
DIRECT FIRING OF MEATS	20	3.392	198	2193
CEMENT PLANTS	40	65.038	167	2182
PHOSPHORIC ACID - THERMAL PROCESS	22	0.102	182	2179
WOOD WASTE BOILERS	20	16.791	172	2174
GRAIN HANDLING - DRYING	27	1.761	144	2156
GRAIN HANDLING - TRANSFER	27	29.365	126	2128
CAST IRON FOUNDRY - ELEC. FURN.	35	0.999	117	2128
PULPBOARD	32	0.411	97	2104
LEAD ACID BATTERY	25	0.013	88	2098
SECONDARY LEAD - POT FURNACE	42	0.004	67	2096
FERROALLOY - SUBMERGED ARC FURNACE	36	5.471	72	2083
STEEL FOUNDRIES	36	4.975	66	2077
DEEP FAT FRYING	36	0.579	61	2072
SMOKED MEAT	25	0.205	65	2065
WHISKEY	31	3.862	58	2064
FEED MILLING - OTHER	35	1.722	54	2063
IRON AND STEEL - SCARFING	36	2.409	53	2059
BLR 10-250 E6 BTU/HR	20	524.167	59	2054
COAL CLEANING - THERMAL DRYING	20	6.137	56	2051
PERLITE	35	0.494	37	2048
SECONDARY COPPER - SMELTING	29	0.740	34	2045
FEED MILLING - ALFALFA DEHYDR.	35	0.821	27	2036
LIME PROCESSING	20	6.338	34	2033

TABLE 3-15
(continued)

EMISSION TRENDS
PARTICULATES

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
SECONDARY LEAD - REVERB	42	0.956	16	2033
IRON AND STEEL - SINTERING	36	9.603	22	2033
IRON & STEEL - EAF	36	28.760	22	2029
SECONDARY COPPER - HANDLING	29	0.733	27	2031
SEC ALUMINUM - REVERB FURNACE	28	1.295	25	2026
MUNICIPAL INCINERATION	26	19.784	24	2025
PLYWOOD - VENEER	20	22.867	26	2021
PETROLEUM REFNRY FCCU	32	23.877	14	2021
FRIT MANUFACTURING	30	1.257	15	2020
SECONDARY LEAD - BLAST	42	0.221	3	2020
INDUSTRIAL/COMMERCIAL INCINERATION	26	6.071	18	2019
CHARCOAL	22	2.986	19	2016
SUGAR CANE - BAGASSE BURNING	20	7.507	20	2015
SECONDARY ZINC - SWEATING	29	0.217	10	2015
BOILERS >3<10 MM BTU/HR	27	494.783	12	2014
BRICK & RELATED CLAY PRODUCTS	30	34.118	6	2011
PATHOLOGICAL INCINERATION	26	0.082	8	2009
PHOSPHATE ROCK - DRYING/HANDLING	20	6.250	13	2008
BLR >250 EA BTU/HR	20	1195.061	12	2007
BEER PROCESSING	25	4.273	5	2005
FERTILIZER - NITRATES	22	4.553	6	2003
PRIMARY ZINC SMELTERS	28	2.361	-3	2000
PHOSPHATE ROCK - CALCINING	20	0.900	5	2000
SYNTHETIC RESINS - POLYESTER	22	3.839	-5	1992

TABLE 3-15
(continued)

EMISSION TRENDS
SOURCES WHICH HAVE AN INCREASING EMISSIONS TREND
$(T_A - T_N)$ LESS THAN OR EQUAL TO ZERO

PRIMARY ALUMINUM SMELTERS
MIXED FUEL BOILERS - COAL & REFUSE
FERTILIZER - AMMONIUM SULFATE
MIXED FUEL BOILERS - OIL & REFUSE
POLYPROPYLENE
SODIUM CARBONATE - NATURAL
CERAMIC CLAY
SYNTHETIC FIBER - DACRON
POLYVINYL CHLORIDE
FERTILIZER - DAP
INTERNAL COMB ENGS DIESEL DUALFUEL
SYNTHETIC FIBER - NYLON
MINERAL WOOL
FIBERGLASS MFG--TEXTILE PRODUCTS
AUTOBODY INCINERATION
CARBON BLACK - FURNACE PROCESS
DETERGENT
EXPLOSIVES - HIGH
SECONDARY ZINC - DISTILLATION
STYRENE - BUTADIENE RUBBER
CASTABLE REFRACTORY
FIBERGLASS MFG--WOOL PRODUCTS
HYDROFLUORIC ACID
SLUDGE INCINERATION
IRON AND STEEL - BLAST FURNACE
IRON & STEEL - BOF
WOOD PULPING KRAFT
WOOD PULPING SULFITE

TABLE 3-15
(continued)

EMISSION TRENDS
SOURCES WHICH HAVE AN INDETERMINANT OBSOLESCENCE RATE
(P_B LESS THAN 0.005)

ASPHALT BATCHING
FISH MEAL PROCESSING

TABLE 3-15
(continued)

EMISSION TRENDS

SOURCES WHICH ARE IN NO - GROWTH CATEGORY
(P_c EQUAL TO ZERO)

SAND AND GRAVEL PROCESSING
MINING/MILLING LEAD ORE
PRIMARY LEAD SMELTERS
ANIMAL FEED DEFLUORINATION
COFFEE ROASTING
SOAP
BRASS \ BRONZE SMELTING

TABLE 3-15
(continued)

EMISSION TRENDS
SOURCES WHICH ARE INDETERMINANT - NO DEMONSTRATED CONTROL TECHNOLOGY

BOILERS <.3 MM BTU/HR
GAS TURBINE ENGINES ELECTRIC UTILITIES
GAS TURBINE ENGINES GAS PIPELINE
ORCHARD HEATERS

TABLE 3-16

EMISSION TRENDS

NITROGEN OXIDES

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	R YEARS	Y YEAR
BLR 10-250 E6 BTU/HR	20	569.568	59	2054
ADIPIC ACID	67	18.211	-23	2019
DMT/TPA NITRIC ACID OXIDATION	22	0.989	11	2008
NITRIC ACID	20	55.056	12	2007
MUNICIPAL INCINERATORS	26	21.982	5	2006
EXPLOSIVES - LOW	22	4.524	6	2005
FIBERGLASS MFG, WOOL PRODUCTS	15	1.154	4	1995
FIBERGLAS MANUF - TEXTILE	16	3.289	0	1991

TABLE 3-18
(continued)

EMISSION TRENDS

SOURCES WHICH HAVE AN INCREASING EMISSIONS TREND
$(T_A - T_N)$ LESS THAN OR EQUAL TO ZERO

GAS TURBINE ENGINES ELECTRIC UTILITIES
BLR >250 E6 BTU/HR
INTERNAL COMBUSTION ENGS SPK IGN
GAS TURBINE ENGINES GAS PIPELINE
MIXED FUEL BOILERS - COAL & REFUSE
INTERNAL COMBUSTION ENGS D/DF
BOILERS <.3 MM BTU/HR
BOILERS >3-10 MM BTU/HR
PORTLAND CEMENT
INDUSTRIAL/COMMERCIAL INCINERATORS
PET REF - PROC GAS COMB
LIME PROCESSING
MIXED FUEL BOILERS - OIL & REFUSE
CERAMIC CLAY
AUTOBODY INCINERATORS

TABLE 3-16
(continued)

EMISSION TRENDS
SOURCES WHICH ARE IN NO - GROWTH CATEGORY
(P_C EQUAL TO ZERO)

COFFEE ROASTING

[illegible]
(continued)

EMISSION TRENDS

SOURCES WHICH ARE INDETERMINANT - NO DEMONSTRATED CONTROL TECHNOLOGY

GLASS - SODA LIME
STEEL FOUNDRIES
BRICK & RELATED CLAY PRODUCTS
COKE OVENS - BY PRODUCT
FERTILIZER - NITRATES
PATHOLOGICAL INCINERATOR
GLASS - OPAL
SEC LEAD - REVERB FURN
MINERAL WOOL
SEC ZINC - DISTILLATION
SEC LEAD - BLAST FURN
SEC ZINC - SWEAT
SEC MAGNESIUM

TABLE 3-17

EMISSION TRENDS

SULFUR OXIDE

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
WOOD PULPING NSSC	32	60.002	133	2162
COPPER SMELTERS	28	58.342	124	2151
WOOD PULPING SULFITE	32	35.451	122	2149
SEC LEAD REVERB FURN	42	1.920	103	2130
SEC LEAD - BLAST FURN	42	0.091	103	2120
FIBERGLASS MANUF - WOOL	16	0.129	108	2099
PRIMARY ZINC SMELTERS	28	46.648	94	2097
WOOD PULPING KRAFT	32	39.066	72	2079
FIBERGLASS MANUF - TEXTILE	16	0.096	36	2027
BLR >250 MM BTU/HR	20	2915.248	30	2026
BRICK & RELATED CLAY PRODUCTS	30	11.160	16	2019
COAL CLEANING	20	20.687	16	2011
BOILERS .3-10 MM BTU/HR	27	2176.613	4	2006
CEMENT PLANTS	40	1336.561	-9	2006
EXPLOSIVES - LOW	22	8.083	6	2003
PET RFNRY PROC GAS COMB	32	10.437	-256	1749

TABLE 3-17
(continued)

EMISSION TRENDS

SOURCES WHICH HAVE AN INCREASING EMISSIONS TREND
$(T_A - T_N)$ LESS THAN OR EQUAL TO ZERO

GAS TURBINE ENGINES ELECTRIC UTILITIES
MIXED FUEL BOILERS - COAL & REFUSE
MIXED FUEL BOILERS - OIL & REFUSE
REFINERY FUEL GAS - SULFUR RECOVERY
OIL AND NAT. GAS PROD-SULFUR RECOVERY
LIME PROCESSING
INTERNAL COMB ENGS DIESEL DUALFUEL
GAS TURBINE ENGINES GAS PIPELINE
ASPHALT BATCHING
COKE OVENS - BY PRODUCT

TABLE 2-17
(continued)

EMISSION TRENDS

SOURCES WHICH ARE IN NO - GROWTH CATEGORY
(P_c EQUAL TO ZERO)

PRIMARY LEAD SMELTERS

TABLE 3-17
(continued)

EMISSION TRENDS

SOURCES WHICH ARE INDETERMINANT - NO DEMONSTRATED CONTROL TECHNOLOGY

PET REF - FCCU
PRIMARY ALUMINUM SMELTERS
BOILERS <.3 MM BTU/HR
IRON AND STEEL - SINTERING
GLASS - SODA LIME
INDUSTRIAL COMMERCIAL INCINERATORS
MUNICIPAL INCINERATORS
ORCHARD HEATERS
GLASS - OPAL
HYDROFLUORIC ACID
MINERAL WOOL

TABLE 3-10

EMISSION TRENDS

HYDROCARBONS

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
COKE OVENS - BY PRODUCT	36	2.865	7130	9141
ASPHALT BLOWING	24	0.057	2460	4439
SEC MAGNESIUM	29	0.000	406	2410
SYNTHETIC RESINS ALKYD	22	0.004	284	2285
WHISKEY	31	0.097	276	2282
DRY CLEANING	20	15.173	168	2163
PLYWOOD-VENEER	20	0.132	167	2162
SEC ZINC SWEAT	29	0.001	152	2156
PATHOLOGICAL INCINERATOR	26	0.002	151	2152
PAINT	15	0.928	162	2152
VARNISH	15	0.551	137	2127
GRAPHIC ARTS-GRAVURE	22	0.315	120	2117
COKE OVENS	36	25.379	98	2109
AUTOMOBILE ASSEMBLY	25	4.139	94	2094
SYNTHETIC FIBERS ACETATE	22	0.128	88	2085
DEEP FAT FRYING	36	0.380	64	2079
GRAPHIC ARTS - LETTERPRESS	22	1.931	72	2069
GRAPHIC ARTS FLEXOGRAPHY	22	2.864	72	2069
GRAPHIC ARTS - LITHOGRAPHY	22	2.064	70	2067
GRAPHIC ARTS - METAL DECORATING	22	1.991	69	2066
FIBERGLASS MANUF - WOOL	16	0.075	69	2060
MALEIC ANHYDRIDE BENZENE OXID.	22	0.132	56	2053
ACRYLONITRILE	22	0.454	45	2050
BEER	25	1.725	43	2043
PETR. - TRANSFER - SP. NAP.	24	0.494	44	2043
DEGREASING	24	212.963	41	2040
ETHYLENE OXIDE - AIR OXIDATION	22	14.230	42	2039
AMMONIA - REGENERATOR & CO ABSORBER	22	13.802	39	2036
TEXTILE - TEXTURIZING	24	0.148	37	2036
AMMONIA - METHANATOR PLANT	22	13.802	39	2036
TEXTILE - CARPET MFG	27	3.109	32	2031
PETR. - REFUELING	12	582.965	25	2031
PETR - SERVICE STATIONS	12	106.589	25	2031
PETR. - TRANSFER - GAS	25	17.398	29	2028
MINERAL WOOL	34	5.057	19	2028

TABLE 3-15
(continued)

EMISSION TRENDS

HYDROCARBONS

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	H YEARS	Y YEAR
PETRLM STRG GASOLINE WRKNG	32	45.235	20	2027
SMOKED MEAT	25	0.333	25	2025
FORMALDEHYDE	22	3.063	27	2024
PETRLM STRG GASOLINE BRTHNG	22	207.956	16	2023
VEGETABLE OIL PRODUCTION	36	89.809	10	2021
PHTHALIC ANHYDRIDE - O-XYLENE	60	36.586	-11	2014
PRINTING INK	22	6.220	6	2003
INDUSTRIAL SURFACE COATING	25	1412.802	5	2003
SYNTHETIC FIBERS NYLON	22	2.973	3	2000
SYNTHETIC RESINS ACRYLIC	22	14.220	-2	1995

TABLE 3-10
(continued)

EMISSION TRENDS

SOURCES WHICH HAVE AN INCREASING EMISSIONS TREND
$(T_A - T_N)$ LESS THAN OR EQUAL TO ZERO

PET REF - MISC PT SOURCE
PETRO. - TANKS - FR - BREATH
POLYETHYLENE - LOW DENSITY
POLYETHYLENE - HIGH DENSITY
POLYVINYL CHLORIDE
PETR. - TRANSFER - CRUDE
PETR. - TRANSFER - JETFUEL
WOOD PULPING KRAFT PROCESS
INTERNAL COMB ENGS DIESEL DUALFUEL
PETR. - TRANSFER - AVGAS
TEXTILE - HEAT SETTING
STYRENE - BUTADIENE RUBBER
AUTOBODY INCINERATORS
PETRLM STRG AV GS BRTHNG
PETRLM STRG CRD OIL WRKNG
PETRLM STRG CRD OIL BRTHNG
PETRLM STRG JET FUEL WRKING
PETRLM STRG JET FUEL BRTHNG
PETRLM STRG SPC NAP BRTHNG
PETRLM STRG AV GS WRKNG

TABLE 3-18
(continued)

EMISSION TRENDS

SOURCES WHICH HAVE AN INDETERMINANT OBSOLESCENCE RATE
(P LESS THAN 0.005)
B

ASPHALT BATCHING
POLYSTYRENE
SYNTHETIC RESINS PHENOLIC
SYNTHETIC RESINS UREA-MELAMINE
POLYPROPYLENE
SYNTHETIC RESINS ABS-SAN

TABLE 7-18
(continued)

EMISSION TRENDS

SOURCES WHICH ARE IN NO - GROWTH CATEGORY
(P_C EQUAL TO ZERO)

PETR. - TANKS - KER - BREATH
COFFEE ROASTING

TABLE 3-18
(continued)

EMISSION TRENDS
SOURCES WHICH ARE INDETERMINANT - NO DEMONSTRATED CONTROL TECHNOLOGY

INTERNAL COMBUSTION ENGS SPKIGN
BOILERS >250 MM BTU/HR
ORCHARD HEATERS
BOILERS >3-10 MM BTU/HR
BOILERS 10-250 MM BTU/HR
INDUSTRIAL COMMERCIAL INCINERATORS
BOILERS <=3 MM BTU/HR
MUNICIPAL INCINERATOR
BRICK & RELATED CLAY PRODUCTS

TABLE 3-18
(continued)

EMISSION TRENDS

SOURCES WHICH ARE INDETERMINANT - ZERO EMISSIONS FROM NSPS CONTROLLE

IF E_N EQUAL TO ZERO

PETRLM REFNRY PRR GAS CO

TABLE 3-19

EMISSION TRENDS

CARBON MONOXIDE

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
ASPHALT BLOWING	24	0.034	2460	4459
IRON AND STEEL - BOF	36	327.401	333	2344
FERRO ALLOY-SUBMERGED ARC FURNACE	36	1.680	271	2282
CARBON BLACK - FURNACE PROCESS	22	6.926	258	2255
WOOD PULPING KRAFT PROCESS	32	121.655	189	2196
PETRLM REFNRY FCCU	32	162.366	97	2104
CHARCOAL	22	2.730	87	2084
PHTHALIC ANHYDRIDE O-XYLENE	50	1.463	45	2070
SEC LEAD - BLAST FURN	42	2.437	46	2067
ACRYLONITRILE	22	0.495	62	2059
ETHYLENE DICHLORIDE	22	0.109	58	2055
AMMONIA - REGENERATOR & CO ABSORBER	22	30.672	39	2036
FORMALDEHYDE	22	15.067	29	2026
IRON AND STEEL - EAF	36	269.624	1	2012

TABLE 3-19
(continued)

EMISSION TRENDS

SOURCES WHICH HAVE AN INCREASING EMISSIONS TREND

$(T_A - T_N)$ LESS THAN OR EQUAL TO ZERO

GAS TURBINE ENGINES ELECTRIC UTILITIES
GAS TURBINE ENGINES GAS PIPELINE
FIBERGLASS MANUF - TEXTILE
FIBERGLASS MANUF - WOOL

TABLE 3-19
(continued)

EMISSION TRENDS
SOURCES WHICH ARE INDETERMINANT - NO DEMONSTRATED CONTROL TECHNOLOGY

IRON AND STEEL - SINTERING
INTERNAL COMBUSTION ENGS SPK IGN
MUNICIPAL INCINERATORS
BOILERS >250 MM BTU/HR
BOILER 10-250 MM BTU/HR
MINERAL WOOL
BOILERS >3-10 MM BTU/HR
INDUSTRIAL COMMERCIAL INCINERATORS
BOILERS <=3 MM BTU/HR
COKE OVENS - BY PRODUCT
BRICK & RELATED CLAY PRODUCTS
AUTOBODY INCINERATORS
CHLOR - ALKALI - DIAPHRAGM CELL
SMOKED MEAT
CHLOR-ALKALI - MERCURY CELL
ORCHARD HEATERS

TABLE 3-19
(continued)

```
                         EMISSION TRENDS
SOURCES WHICH ARE INDETERMINANT  +  ZERO EMISSIONS FROM NSPS CONTROLLED
     IE  EQUAL TO ZERO
       N


         INTERNAL COMB ENGS DIESEL DUALFUEL
         IRON AND STEEL - BLAST FURNACE
         SEC ZINC - SWEAT
         SEC MAGNESIUM
```

TABLE 3-20

EMISSION TRENDS

FLUORIDES

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T 2000	MIN TONS/YR	K YEARS	Y YEAR
HYDROFLUORIC ACID	27		5.132	228.	2201
FRIT MFG	25		5.776	164	2171
BLR IC + 250 E6 BTU/HR	25		1.874	123	2116
GLASS MFG	30		1.462	61	2068
CASTABLE REFRACTORS	35		5.336	43	2066
FIBERGLASS TEXT. PROD.	15		5.172	36	2027
BLR >250 E6 BTU/HR	25		5.646	31	2027
BLR 0-3-IC E6 BTU/HR	25		1.878	27	2025
CERAMIC CLAY	30		3.770	11	2016
IRON & STEEL - ELEC ARC	30		5.283	4	2013
PRIM ALUM SMLTNG	20		66.905	2	2006
PHOSPHORIC ACID-WET P	27		5.007	0	1997
DIAMMON PHOS FERTLZR	22		5.182	-1	1996
GRN TPL SUPERPHOS PRD	27		5.133	-1	1996
RUN TPL SPRPHOS STG	22		5.513	-2	1995

TABLE 3-20
[illegible]

[illegible] [illegible]

SOURCES WHICH HAVE AN ELIMINATING FRACTIONAL THEAD
IF [illegible] + T [illegible] LESS THAN OR EQUAL TO ZERO

[illegible]
IRON & STEEL - BOF

TABLE 3-25
(continued)

EMISSION TRENDS
SOURCES WHICH HAVE AN INDETERMINANT OBSOLESCENCE RATE
(P LESS THAN 0.005)
a

SPRPHSHC ACD SUS EMB

TABLE 3-20
(continued)

EMISSION TRENDS
SOURCES WHICH ARE IN NO - GROWTH CATEGORY
(P_C EQUAL TO ZERO)

ANIMAL FEED DEFLUORND

TABLE 3-21

EMISSION TRENDS

HAZARDOUS POLLUTANTS

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
COTTON GINNING	25	0.001	187	2186
PESTICIDES	20	0.213	43	2040
PHARMACEUTICALS	22	0.031	-2	1995

TABLE 3-21
(continued)

EMISSION TRENDS

SOURCES WHICH HAVE AN INCREASING EMISSIONS TREND
(T_A - T_N) LESS THAN OR EQUAL TO ZERO

CHLR-AKLI MERC CELL

TABLE 3-22

EMISSION TRENDS

ACID MIST

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
CERAMIC CLAY	30	7.967	295	2300
LEAD ACID BATTERY	25	0.000	164	2164
SEC ALUM REVRB FURN	28	0.312	124	2127
SULFURIC ACID	22	6.384	33	2030
HYDRBCHLRC ACID BYPD	22	0.481	30	2027

TABLE 3-22
(continued)

EMISSION TRENDS
SOURCES WHICH HAVE AN INDETERMINANT OBSOLESCENCE RATE
(P_B LESS THAN 0.004)

SPRPHSPHNC ACD SP CM

TABLE 3-21

EMISSION TRENDS

LEAD

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
SEC LEAD POT FURN	42	0.002	69	2086
FERROALLOY	36	0.005	72	2063
SEC LEAD - REVERB FURNACE	42	0.601	15	2033
SEC LEAD - BLAST FURNACE	42	0.120	3	2020

TABLE 4-23
(continued)

EMISSION TRENDS
SOURCES WHICH HAVE AN INDETERMINANT OBSOLESCENCE RATE
(P_B LESS THAN 0.005)

COMM NAT CNNKESE OIL

TABLE 3-23
(continued)

EMISSION TRENDS

```
SOURCES WHICH ARE IN NO - GROWTH CATEGORY
      (R  EQUAL TO ZERO )
        C


            PRIMARY LEAD SMELTERS
            BRASS & BRONZE SMELTING
            MINING & MILLING LEAD
```

TABLE 3-23
(continued)

EMISSION TRENDS
SOURCES WHICH ARE INDETERMINANT - NO DEMONSTRATED CONTROL TECHNOLOGY

LEAD ACID BATTERY

TABLE 3-24

EMISSION TRENDS

AMMONIA

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	R YEARS	Y YEAR
BY-PRODUCT COKE OVEN	36	0.096	9459	11470
DIAMMONIUM PHOS FERT	22	0.245	428	2425
PET REFNRY FCCU	32	2.643	62	2059
NITRATE FERTILIZER	22	0.735	36	2033
AMMONIA REGNTR & CO AD	22	63.491	32	2029

TABLE [illegible]
(continued)

EMISSION TRENDS

```
SOURCES WHICH HAVE AN INDETERMINANT OBSOLESCENCE RATE
     (P  LESS THAN  0.005 )
       0


          SOD CARBNTE SOLVAY
          BEEHIVE COKE OVEN
          PET REFNRY TCCU/HCCU
```

TABLE 3-25

EMISSION TRENDS

SULFIDES

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	T YEAR
SYN FIBERS VISC RAY	22	3.046	354	2301
CARBON BLACK FURNACE	22	0.045	254	2255
WOOD PULPING KRAFT	35	31.387	160	2167
BY-PRODUCT COKE OVEN	36	224.407	47	2058

TABLE 3-25
(continued)

EMISSION TRENDS
SOURCES WHICH HAVE AN INDETERMINANT OBSOLESCENCE RATE
(P_B LESS THAN 0.005)

BEEHIVE COKE OVEN
FISH PRCSSNG

TABLE 3-25
(continued)

EMISSION TRENDS

SOURCES WHICH ARE INDETERMINANT - ZERO EMISSIONS FROM NSPS CONTROLLED
(E_N EQUAL TO ZERO

REF FUEL GAS S RECOV
CRD OIL & NAT GAS S RECOV

TABLE 3-26

EMISSION TRENDS

CHLORINE

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	H YEARS	Y YEAR
MUNCPAL INCINERATION	26	0.798	173	2175
SEC ALUM REVERB FURN	28	0.158	124	2127
CHLR-AKLI MERC CELL	22	0.071	127	2124
CHLR-AKLI DIAP CELL	22	0.184	120	2117

TABLE 3-37

EMISSION TRENDS

TRACE METALS

SOURCE CATEGORY	AVERAGE RETIREMENT AGE YEARS	T MIN 1000 TONS/YR	N YEARS	Y YEAR
FRIT MANUFACTURING	30	0.058	188	2193
BLR 10-250 E6 BTU/HR	20	0.743	58	2053
BLR .3-10 E6 BTU/HR	27	4.434	12	2014
PATHOLOGICAL INCINERATORS	26	0.006	6	2009
IRON & STEEL - ELEC ARC	36	6.843	-3	2006
PET REFINRY FCCU	32	3.123	-18	1989

TABLE 3-27
(continued)

EMISSION TRENDS

SOURCES WHICH HAVE AN INCREASING EMISSIONS TREND

$(T_A - T_N)$ LESS THAN OR EQUAL TO ZERO

IRON & STEEL - OHF
IRON & STEEL BLST FURN
BLR >250 E6 BTU/HR

TABLE 3-27
(continued)

EMISSION TRENDS
SOURCES WHICH HAVE AN INDETERMINANT OBSOLESCENCE RATE
(P_B LESS THAN 0.008)

PET REFNRY TCCU/HCCU

TABLE 3-27
(continued)

EMISSION TRENDS

SOURCES WHICH ARE IN NO - GROWTH CATEGORY
(P_C EQUAL TO ZERO)

BRASS & BRONZE SMELTING

TABLE 3-27
(continued)

EMISSION TRENDS
SOURCES WHICH ARE INDETERMINANT - NO DEMONSTRATED CONTROL TECHNOLOGY

BLR <3 E6 BTU/HR

REFERENCES

1. *Priorities for the Development of Standards of Performance*, Draft, D. W. Walsh, Emission Standards and Engineering Division, EPA, Durham, N. C., November 13, 1972.

2. *The Clean Air Act* (42 U.S.C. 1857 et seq., as amended by the Air Quality Act of 1967, PL 90-148, by the Clean Air Amendments of 1970, PL 91-604, by Technical Amendments to the Clean Air Act, PL 92-157, by PL 93-15, HR 5445, April 9, 1973; by PL 93-319, June 24, 1974).

3. *Federal Register*, Volume 39, Number 195, October 7, 1974; 40 CFR Part 60, FRL 237-1.

APPENDIX A

COMPUTER PROGRAM FOR MODEL IV

```
C** SWITCHING CODES
C    ISW=+POSITIVE GIVES ASCENDING ORDER
C       =ZERO GIVES NO REORDERING
C       =NEGATIVE GIVES DESCENDING ORDER
C
C          0:::ORDERS EACH POLLUTANT GROUP SUCCESSIVELY IRU=1 TO IRU=21
C    IRU   1:::A
C          2:::B
C          3:::C
C          4:::EN
C          5:::ES
C          6:::ESN
C          7:::EU
C          8:::EO
C          9:::E110
C         10:::PO
C         11:::PC-C
C         12:::PC-S
C         13:::PKE
C         14:::TU
C         15:::TA
C         16:::TE
C         17:::TUE
C         18:::TS
C         19:::TN
C         20:::TO
C         21:::TNO
C
C    IF NO RANKING IS REQUIRED
C    AND ISW = 0
C    SET IRU = 1
      INTEGER L,S
      REAL LIMIT
      DIMENSION PS(110)
      DIMENSION FA(29),FU(27),FC(39),VX(10),FAP(24),FCP(36)
      DIMENSION VARA(110,3),VARB(110,7),LIMIT(5)
      DIMENSION A(110),B(110),C(110),EN(110),ES(110),ESN(110),EU(110)
      DIMENSION EO(110),E110(110),PO(110),PC(110),PK(110),PKE(110)
      DIMENSION  END(20)
      DIMENSION TA(110),TO(110),TE(110),TN(110),TNO(110),TS(110),TU(110)
      DIMENSION TUE(110)
      DIMENSION ITN(110),ITO(110),IRATNG(2,110),IPLINT(10,15)
      DIMENSION ITNO(110),ITUE(110),ITE(110),ALSET(110,21)
      DIMENSION IS(110),IG(110),IALFA(5,8),IBETA(5,8)
      DIMENSION IEUNIT(10,110),IUNIT(10,110),IOUTC(20,110)
      DIMENSION INPO(110),INPC(110),ITU(110),ITA(110),ITS(110)
      DIMENSION IO(110)
      EQUIVALENCE (VARA(1,1),A),(VARA(1,2),B),(VARA(1,3),C)
      EQUIVALENCE (VARB(1,1),TU),(VARB(1,2),TA),(VARB(1,3),TE)
      EQUIVALENCE (VARB(1,4),TUE),(VARB(1,5),TS),(VARB(1,6),TN),
     *      (VARB(1,7),TO)
      EQUIVALENCE (ALSET(1,1),A)
      EQUIVALENCE (ALSET(1,4),EN),(ALSET(1,5),ES),(ALSET(1,6),ESN),
     *    (ALSET(1,7),EU),(ALSET(1,8),EO),(ALSET(1,9),E110),
     *     (ALSET(1,10),PO),(ALSET(1,11),PC),(ALSET(1,12),PS),
     *      (ALSET(1,13),PKE),(ALSET(1,14),TU),(ALSET(1,21),TNO)

      DATA FIX1,FIX2,FIX3,FIX4/'(5,0',',4X,','   F','(4,F'/
      DATA IC,IS/1HC,1HS/
      DATA LIMIT/100.,1.,.1,.01,.001/
      DATA L/5/IHL/1H$/
      DATA IALFA/2H  ,2HLB,2H/D,2HAL,2H  ,2HLB,2H/E,2HG ,2HCF,2HT ,
     1           2H  ,2HLB,2H/T,2HON,2H  ,2HLB,2H/E,2HG ,2HBT,2HU ,
     2           2H L,2HB/,2HBA,2HLE,2H  ,2HLB,2H/G,2HAL,2HBE,2HL ,
     3           2H  ,2HLB,2H/C,2HYD,2H  ,2HLB,2H/P,2HRS,2H U,2HNT/
      DATA ITETA/2HEA,2H D,2HAL,2H  ,2HEA,2H C,2HFT,2H  ,2HEA,2H T,2HON,
     12H0 ,2HBT,2H0 ,2HBT,2HU ,2HEA,2H B,2HAL,2HE ,2HEA,2H G,2HAL,2H  ,
     12HEA,2H C,2HYD,2H  ,2HEA,2H P,2HU ,2H  /
      K=1
  601 FORMAT (20A4)
      READ (1,601) (FA1(I),I=1,29)
      READ(1,601) (FA2(I),I=1,29)
      READ(1,601)  (FU(I),I=1,27)
      READ(1,601) (FC1(I),I=1,36)
      READ(1,601) (FC2(I),I=1,36)
      READ(1,601) (FS(I),I=1,10)
C** READING IN THE NUMBER OF POLLUTANTS
      READ (1,99) NI
 99   FORMAT(/I5)
   50 CONTINUE
C** READ SWITCHING CODES
      READ(1,99) ISW,ISU
  100 FORMAT(A5)
C** READING IN THE NAME OF THE POLLUTANT
      READ (1,101) (IPLTNT(J,K),J=1,10)
  101 FORMAT (10A2)
      WRITE (60)   (IPLTNT(J,K), J = 1,10)
      DO 750 I=1,9999
C** READING IN THE NAMES OF THE VARIOUS SOURCES AND THEIR RATING
      READ(1,102,END=75) ((SOURC(J,I),J=1,20),(RATNG(J,I),J=1,2),
     *      E(I),D(I),EN(I),END(I))
  102 FORMAT (20A2,2A2,1X,2F10.0,12X,2A2)
C** READING IN VARIOUS OTHER INFORMATION (EMISSIONS,PROD. CAPACITY ETC.)
C** FOR EACH OF THE SOURCES
      READ(1,103) PK(I),PKE(I),IS(I),ES(I),EN(I),EU(I),PB(I),IRPB(I),PC(
     *I),IRPC(I),IA(I),A(I)
  103 FORMAT(F3.1,F5.4,I3,4F10.0,A1,F10.0,A1,I3,E11.0)
      IF (PK(I).EQ.0) GO TO 750
C** DECIDING WHETHER TO USE SIMPLE OR COMPOUND GROWTH TO CALCULATE
C** PROD. CAPACITY FROM CONSTRUCTION AND MODIFICATION
      IF (IRPB(I).EQ.S) GO TO 80
      B(I)=((1.0+PB(I))**10-1.0)*A(I)
      GO TO 81
 80   B(I)=10*A(I)*PB(I)
 81   IF (IRPC(I).EQ.S) GO TO 82
      C(I)=((1.0+PC(I))**10-1.0)*A(I)
      GO TO 83
 82   C(I)=10*A(I)*PC(I)
C** CALCULATING TOTAL EMISSIONS IN TONS/YEAR
   83 IF (ESN(I).EQ.0.)    ESN(I) = ES(I)
      IF (PKE(I).EQ.0.)    PKE(I) = PK(I)
      TU(I)=EU(I)*((PKE(I)*(A(I)-B(I)))+(PK(I)*(B(I)+C(I))))/2.0E6
      IF (ES(I).EQ.0.0) ES(I)=EU(I)
      TA(I)=(A(I)*ES(I)*PK(I))/2.0E6
      TS(I)=  ((PKE(I)*ES(I)*(A(I)-B(I)))+(PK(I)*ESN(I)*(B(I)+C(I))))/2.
     *0E3
      EQ(I)= (1. - (EN(I)/ESN(I)))
      TN(I)=  (PKE(I)*ES(I)*(A(I)-B(I)) + PK(I)*EN(I)*(B(I)+C(I)))/2.0E3
      TUE(I)=(PKE(I)*EU(I)*(A(I)-B(I)))/2.0E3
      TC(I)=(PKE(I)*C3(I)*(A(I)-B(I)))/2.0E3
      IF (FI(ID(I)).EQ.0.) GO TO 600
      TND(I) = (FI(ID(I))*PKE(I)*(A(I)-B(I)) + EN(I)*PK(I)*(B(I)+C(I)))/2
     *.0E3
  600 IF(IS(I).EQ.P) GO TO 20
      XL=1.0E6
      TND(I)=TND(I)*RL
      TU(I)=TU(I)*RL
      TA(I)=TA(I)*RL
      TS(I)=TS(I)*RL
      TN(I)=TN(I)*RL
      TUE(I)=TUE(I)*RL
      TE(I)=TE(I)*RL
C** ROUNDING OFF THE TOTAL EMISSIONS
C     ITU(I)=TU(I)
C     ITA(I)=TA(I)
C     ITS(I)=TS(I)/1000
C     ITN(I)=TN(I)/1000
      ITND(I)=TND(I)/1000.
      ITUE(I)=TUE(I)/1000.
      ITE(I)=TE(I)/1000.
   80 TD(I)=(TS(I)-TN(I))
      IF(C11D(I).NE.0.0)TD(I)=TS(I)-TND(I)
      TS(I) = TS(I)/1000.
      TN(I) = TN(I)/1000.
      TND(I)=TND(I)/1000.
      TUE(I)=TUE(I)/1000.
      TE(I)=TE(I)/1000.
C** CALCULATING THE ESTIMATED REDUCED EMISSIONS RESULTING FROM NEW
C** OR REVISED NSPS
      IF (TD(I).LT.10.) GO TO 91
      IF (TD(I).GE.1000000.) GO TO 90
      IF (TD(I).GE.100000.) GO TO 89
      IF (TD(I).GE.1000.) GO TO 88
      ITD(I) = TD(I)/10
      TD(I) = 10.*ITD(I)
      GO TO 91
   88 ITD(I)=TD(I)/100
      TD(I) = ITD(I)
      TD(I) = 100.*TD(I)
      GO TO 91
   89 ITD(I)=TD(I)/1000
      TD(I) = ITD(I)
      TD(I) = 1000.*TD(I)
      GO TO 91
   90 ITD(I) = TD(I)/10000
      TD(I) = ITD(I)
      TD(I) = 10000.*TD(I)
 91   IB=IG(I)
      DO 1 J=1,5
C** OBTAINING THE ACTUAL UNITS OF TOTAL EMISSIONS AND EMISSION RATES
C** FROM THE VARIOUS CODE NUMBERS THAT WERE READ IN AS SUBSTITUTE FOR
C** THE UNITS
 1    IEUNIT(J,I)=IALFA(J,IB)
 92   IB=IA(I)
      DO 2 J=1,6
 2    IIUNIT(J,I)=IBETA(J,IB)
 750  CONTINUE
   94 ISAVE=I - 1
      DO 757 IJ=1,ISAVE
      PS(IJ)=PC(IJ)
  757 CONTINUE

      IS=1
      JS=21
      IF (ISU .EQ. 0)   GO TO 95
      IS=ISU
      JS=ISU
   95 DO 96 ISU=IS,JS
      IF (ISU .EQ. 9 .AND. E11D(I) .EQ. 0.0)   GO TO 96
      IF (ISU .EQ. 19 .AND. E11D(I) .NE. 0.0)   GO TO 96
      IF (ISU .EQ. 21 .AND. E11D(I) .EQ. 0.0)   GO TO 96
      CALL BNDLP(ALSET(1,IBU),IG,ISAVE,ISW)
C** PRINTING OUT THE RESULTS IN A TABULAR FORM
C
C   PRINT PAGE 'A' HERE
C
   97 M=2
   98  I=1
       KK=1
       KS=1
  751 ICNT = 0
      WRITE(3,401)        (IPLTNT(J,K),J=1,10)
  401 FORMAT (1H1, 9X,               //50X,10A2//46X,'SUMMARY OF INPUT
     X/OUTPUT VARIABLES'/58X,'FOR MODEL IV')
      IF(E111D(IG(I)))  405,404,405
C
C** IF E111D .EQ. 0.
C   WRITE HEADING HERE
  404 WRITE(3,402)
  402 FORMAT(///,9X,'SOURCE',27X,'EMISSION RATES',11X,'GROWTH RATES',30X
     X'INDUSTRY'/26X,'EMISSION    ALLOWABLE',6X,'UNCONT      DECIMAL/YR',
     X25X,'CAPACITY/PRODUCTION'/16X,'R', 9X,'UNITS      E        E
     X   E        P             P',22X,'A',12X,'S',10X,'L'/39X,'S       N
     X        U         B          C    UNITS/YR        1975         1985
     X      1985'/)
       GO TO 323
C
C** IF E111D .NE. 0.
C   WRITE HEADING HERE
  405 WRITE(3,422)
  422 FORMAT (///,4X,'SOURCE',36X,'EMISSION RATES', 8X,'GROWTH RATES',
     X28X,'INDUSTRY'/16X,'EMISSION',11X,'ALLOWABLE',8X,'UNCONT',11X,
     X'DECIMAL/YR',29X,'CAPACITY/PRODUCTION'/11X,'R', 8X,'UNITS       E'
     X10X,'E',10X,'E',6X,'E',9X,'P',5X,'P',21X,'A',11X,'S',11X,'C',
     X/30X,'S',10X,'N',10X,'U',6X,'111D',6X,'B',9X,'C',5X,'UNITS/YR',6X,
     X'1975',8X,'1985',7X,'1985'/)
  323 IF (IBU .EQ. 11 .AND. IRPC(IG(I)) .EQ. 19)   GO TO 4470
      IF (IBU .EQ. 12 .AND. IRPC(IG(I)) .EQ. 1C)   GO TO 4470
      IF (IBU .EQ. 6 .AND. ESN(IG(I)) .EQ. ES(IG(I)))   GO TO 4470
      WRITE(3,403) (ISRC(J,IG(I)),J=1,20)
  403 FORMAT (2X,A2,20A2)
   13 IF(PXE(IG(I))-PX(IG(I)))  15,14,15
   14 IF(ESN(IG(I))-ES(IG(I)))  15,16,15
   15 ZZ=0.
      GO TO 17
   16 ZZ=1.
   17 CONTINUE
      IF(ZZ .EQ. 0.)  GO TO 1100
      IF(E111D(IG(I)))  1313,1111,1313
C
C** IF PXE AND ESN DO NOT EXIST
C   AND E111D .EQ. 0.
C   FORMAT HERE
 1111 DO 111  K=1,3
   19 IF (K .EQ. 1)  KK=15
      IF (K .EQ. 2)  KK = 19
      IF (K .EQ. 3)  KK = 23
   21 DO 112 L=1,5
      IF (VARA(IG(I),K)  .EQ. 0.)  GO TO 120
      IF (VARA(IG(I),K) .GE. LIMIT(L))  GO TO (110,120,130,140,150),L
      GO TO 112
  110 FA(KK) = FX(1)
      FA(KK+1) = FX(2)
      GO TO 111
  120 FA(KK) = FX(3)
      FA(KK+1) = FX(4)
      GO TO 111
  130 FA(KK) = FX(5)
      FA(KK+1) = FX(6)
      GO TO 111
  140 FA(KK) = FX(7)
      FA(KK+1) = FX(8)
      GO TO 111
  150 FA(KK) = FX(9)
      FA(KK+1) = FX(10)
  112 CONTINUE
  111 CONTINUE
      GO TO 2000
C
C** IF PKE AND ESN DO NOT EXIST
C    AND L(11D .NE. 0.
C    FORMAT HERE
 1317 DO 313  K=1,3
      IF(K .EQ. 1)  KK=17
      IF(K .EQ. 2)  KK=20
      IF(K .EQ. 3)  KK=23
      DO 314 L=1,5
      IF(VARA(IO(I),K) .EQ. 0.)  GO TO 320
      IF(VARA(IO(I),K) .GE. LIMIT(L))  GO TO (410,420,430,440,450),L
      GO TO 314
  410 FAP(KK) = FX(1)
      FAP(KK+1) = FX(2)
      GO TO 313
  420 FAP(KK) = FX(3)
      FAP(KK+1) = FX(4)
      GO TO 313
  430 FAP(KK) = FX(5)
      FAP(KK+1) = FX(6)
      GO TO 313
  440 FAP(KK) = FX(7)
      FAP(KK+1) = FX(8)
      GO TO 313
  450 FAP(KK) = FX(9)
      FAP(KK+1) = FX(10)
  314 CONTINUE
  313 CONTINUE
      GO TO 2000
 1120 IF(L(11D(IO(I)))  23,22,23
C
C** IF PKE AND ESN EXIST
C    AND L(11D .EQ. 0.
C    FORMAT HERE
   22 DO 311  K=1,3
      IF(K .EQ. 1)  KK=18
      IF(K .EQ. 2)  KK=21
      IF(K .EQ. 3)  KK=24
      DO 312 L=1,5
      IF(VARA(IO(I),K) .EQ. 0.)  GO TO 320
      IF(VARA(IO(I),K) .GE. LIMIT(L))  GO TO (310,320,330,340,350),L
      GO TO 312
  310 FC(KK) = FX(1)
      FC(KK+1) = FX(2)
      GO TO 311
  320 FC(KK) = FX(3)
      FC(KK+1) = FX(4)
      GO TO 311
  330 FC(KK) = FX(5)
      FC(KK+1) = FX(6)
      GO TO 311
  340 FC(KK) = FX(7)
      FC(KK+1) = FX(8)
      GO TO 311
  350 FC(KK) = FX(9)
      FC(KK+1) = FX(10)
  310 CONTINUE
  311 CONTINUE
      GO TO 2000
C
C** IF PKE AND ESN EXIST
C    AND E11ID .NE. 0.
C    FORMAT HERE
   23 DO 315  K=1,3
      IF(K .EQ. 1)  KK=20
      IF(K .EQ. 2)  KK=23
      IF(K .EQ. 3)  KK=26
      DO 316  L=1,5
      IF(VARA(IG(I),K) .EQ. 0.)  GO TO 520
      IF ( VARA(IG(I),K) .GE. LIMIT(L))  GO TO (510,520,530,540,550),L
      GO TO 316
  510 FC2(KK) = FX(1)
      FC2(KK+1) = FX(2)
      GO TO 315
  520 FC2(KK) = FX(3)
      FC2(KK+1) = FX(4)
      GO TO 315
  530 FC2(KK) = FX(5)
      FC2(KK+1) = FX(6)
      GO TO 315
  540 FC2(KK) = FX(7)
      FC2(KK+1) = FX(8)
      GO TO 315
  550 FC2(KK) = FX(9)
      FC2(KK+1) = FX(10)
  316 CONTINUE
  315 CONTINUE
 2000 IF (E11ID(IG(I)))  443,444,443
  443 IF(Z2)  442,441,442
C
C** IF PKE AND ESN EXIST
C    AND E11ID .NE. 0.
C    WRITE HERE
  441 WRITE(3,FC2)                         PK(IG(I)),(IEUNIT(J,IG(I)),
     &J=1,5),CS(IG(I)),EV(IG(I)),EU(IG(I)),E11ID(IG(I)),PS(IJ(I)),IRPS(I
     &G(I)),PC(IG(I)),IRPC(IG(I)),(IUNIT(J,IG(I)),J=1,4),A(IG(I)),B(IG
     &(I)),C(IG(I)),PKL(IG(I)),ESN(IG(I))
       ICNT = ICNT + 3
       GO TO 447
C
C** IF PKE AND ESN DO NOT EXIST
C    AND E11ID .NE. 0.
C    WRITE HERE
  442 WRITE(3,FC1)  ((NATNO(J,IG(I)),J=1,2),PK(IG(I)),(IEUNIT(J,IG(I)),
     &J=1,5),CS(IG(I)),EV(IG(I)),EU(IG(I)),E11ID(IG(I)),PS(IJ(I)),IRPS(I
     &G(I)),PC(IG(I)),IRPC(IG(I)),(IUNIT(J,IG(I)),J=1,4),A(IG(I)),B(IG
     &(I)),C(IG(I)))
       ICNT = ICNT + 2
       GO TO 447
C
  444 IF(Z2)  446,445,446
C
C** IF PKE AND ESN EXIST
C    AND E11ID .EQ. 0.
C    WRITE HERE
  445 WRITE(3,FC)   ((NATNO(J,IG(I)),J=1,2),PK(IG(I)),(IEUNIT(J,IG(I)),
     &J=1,5),CS(IG(I)),EV(IG(I)),EU(IG(I)),           PS(IJ(I)),IRPS(I
     &G(I)),PC(IG(I)),IRPC(IG(I)),(IUNIT(J,IG(I)),J=1,4),A(IG(I)),B(IG
     &(I)),C(IG(I)),PKL(IG(I)),ESN(IG(I))),
       ICNT = ICNT + 3
      GO TO 447
C
C** IF PKE AND ESN DO NOT EXIST
C   AND E111D .EQ. 0.
C   WRITE HERE
  446 WRITE(13,FA)   ((RATNG(J,IQ(I)),J=1,8),PK(IQ(I)),((EUNIT(J,IQ(I))),
     *J=1,4),ES(IQ(I)),E(IQ(I)),EU(IQ(I)),             PS(IQ(I)),IRPS(I
     *Q(I)),PC(IQ(I)),IRPC(IQ(I)),((UNIT(J,IQ(I))),J=1,4),A(IQ(I)),B(IQ(
     *I)),C(IQ(I)))
      ICNT = ICNT + 5
  447 IF (I .EQ. ISAVE)  GO TO 752
      I = I + 1
      IF(ICNT.GE.42)   ICNT=0
      K=M
      IF (ICNT .EQ. 0)   GO TO 751
      GO TO 323
C
C   PRINT PAGE 'B' HERE
C
  752 I = 1
  753 ICNT = 0
      WRITE(13,501)      ((PLTNT(J,M),J=1,10)
  501 FORMAT(1H1,24X,              //58X,10A8 //51X,'SUMMARY OF OUTPUT
     *T VARIABLE'//58X,'FOR MODEL IV'//)
      IF(E111D(IQ(I))) 504,503,504
C
C** IF E111D .NE. 0.
C   WRITE HEADING HERE
  504 WRITE(13,505)
  505 FORMAT(/6X,'SOURCE',53X,'EMISSIONS'/56X,'1000 TONS/YEAR',30X,'TONS
     */YEAR'/25X,'T',12X,'T',11X,'T',12X,'T',12X,'T',12X,'T',12X,'I =T',
     *11X,'I = E /E '/26X,'V',12X,'A',12X,'E',12X,'UE',11X,'S',12X,'ND',
     *11X,'S  ND',14X,'N  S' /25X,'1985',9X,'1975',9X,'1985',9X,'1985',9
     *X,'1985',9X,'1985',11X,'1985'/)
      GO TO 384
C
C** IF E111D .EQ. 0.
C   WRITE HEADING HERE
  503 WRITE(13,502)
  502 FORMAT(/6X,'SOURCE',53X,'EMISSIONS'/56X,'1000 TONS/YEAR',32X,'TONS
     */YEAR'/25X,'T',12X,'T',12X,'T',12X,'T',12X,'T',12X,'T',12X,'I =T',
     *11X,'I = E /E '/26X,'V',12X,'A',12X,'E',12X,'UE',11X,'S',12X,'N',1
     *2X,'S  N',15X,'N  S '/25X,'1985',9X,'1975',9X,'1985',9X,'1985',9X
     *,'1985',9X,'1975',11X,'1985'/)
  384 IF (IBU .EQ. 11 .AND. IRPC(IQ(I)) .EQ. 15)   GO TO 5540
      IF (IBU .EQ. 12 .AND. IRPC(IQ(I)) .EQ. 16)   GO TO 5540
      IF (IBU .EQ. 6 .AND. ESN(IQ(I)) .EQ. ES(IQ(I)))   GO TO 5580
      WRITE (13,503) ENO(IQ(I)),(SOURC(J,IQ(I)),J=1,20)
      IF(E111D(IQ(I)))  77,78,77
   77 TNI(IQ(I)) = TNO(IQ(I))
   78 CONTINUE
      ICNT = ICNT + 1
      DO 211  K=1,7
      IF (K .EQ. 1)  KK= 3
      IF (K .EQ. 2)  KK = 6
      IF (K .EQ. 3) KK = 9
      IF (K .EQ. 4)  KK = 12
      IF (K .EQ. 5)  KK = 15
      IF(K .EQ. 6)  KK=19
      IF(K .EQ. 7)  KK=22
      DO 212  L=1,7
      FR(2)=FIX4
      IF (VARR(IQ(I),K) .GE. 1.E+6)   FR(KK) = FIX1
      IF (VARR(IQ(I),K) .GE. 1.E+4)   FR(KK+1)= FIX2
      IF (VARR(IQ(I),K) .GE. 1.E+6)   FR(KK-1)= FIX3
      IF (VARR(IQ(I),K) .GE. 1.E+6)   GO TO 211
      IF (VARD(IQ(I),K) .EQ. 0.)  GO TO 220
      IF (VARD(IQ(I),K) .GE. LIMIT(L))  GO TO (210,220,230,240,250),L
      GO TO 212
  210 FB(KK) = FX(1)
      FB(KK+1) = FX(2)
      GO TO 211
  220 FB(KK) = FX(3)
      FB(KK+1) = FX(4)
      GO TO 211
  230 FB(KK) = FX(5)
      FB(KK+1) = FX(6)
      GO TO 211
  240 FB(KK) = FX(7)
      FB(KK+1) = FX(8)
      GO TO 211
  250 FB(KK) = FX(9)
      FB(KK+1) = FX(10)
  212 CONTINUE
  211 CONTINUE
  555 WRITE(3,FB)  TU(IQ(I)),TA(IQ(I)),TE(IQ(I)),TUE(IQ(I)),TS(IQ(I)),
     *      TN(IQ(I)),TO(IQ(I)),EQ(IQ(I))
      IF (PK(IQ(I)).NE.0.)   GO TO 556
      PK(IQ(I)) = PKL(IQ(I))
      IF (E(IIQ(IQ(I))).EQ.0)  GO TO 556
      TN(IQ(I)) [illegible] TNO(IQ(I))
  556 JJ = I[illegible]
      WRITE (8[illegible] (SOURC(J,JJ), J = 1,20),PK(JJ),PS(JJ),PE(JJ),IRPE(JJ)
     *,EN(JJ),TN(JJ),TA(JJ),ENU(JJ),A(JJ)
  448 IF ( I .EQ. ISAVE)  GO TO 432
      I = I + 1
      IF(ICNT.EQ.20)   ICNT=0
      IF (ICNT .EQ. 0)   GO TO 785
      GO TO 324
  432 K=M
   96 CONTINUE
      K = K+ 1
      IF (K.GT.K1) GO TO 359
      GO TO 50
  359 WRITE(3,666)
  666 FORMAT(1H1)
      END FILE  80
      REWIND    80
      CALL EXIT
 4480 IF (I .EQ. ISAVE)   GO TO 432
      I=I+1
      K=M
      GO TO 324
 4470 IF (I .EQ. ISAVE)   GO TO 702
      I=I+1
      K=M
      GO TO 323
      END
```

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                                   SCALAR MAP

L        001F(P)  B       001F(P)  FIX1    000A(P)  FIX2    000C(P)  FIX3    000E(P)  [illegible]
IC       0012(P)  IS      0013(P)  D       0010(T)  I       0011(T)  KI      0015(T)  [illegible]
IQU      001A(T)  J       001?(T)  KL      122F(T)  IA      1231(T)  IB      1233(T)  [illegible]
IJ       1235(T)  IX      1236(T)  JB      1237(T)  M       1238(T)  KG      1239(T)  [illegible]
ICNT     123D(T)  II      123C(T)  KK      123E(T)  JJ      1240(T)

                                   ARRAY MAP

LIMIT    0013(P)  FD      098C(T)  FA      1U82(T)  FB      1282(T)  FC      12C8(T)  [illegible]
FAP      121A(T)  FC2     135C(T)  VARA    031A(T)  VARD    0455(T)  A       0518(T)  [illegible]
C        0100(T)  EN      02AC(T)  ES      0348(T)  FSN     0484(T)  EU      0540(T)  [illegible]
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K111D   06F8(T)  PP      07D4(T)  PC      08B0(T)  PK      1394(T)  PKE     0A68(T)  E
TA      0CF0(T)  TG      106C(T)  TE      0CFC(T)  TH      0F90(T)  THD     1148(T)  7
TV      0B44(T)  TUE     0DD8(T)  ITV     1498(T)  ITD     1506(T)  IHATNG  1574(T)  I
ITND    18E8(T)  ITUE    1754(T)  ITF     17CF(T)  ALSET   0018(T)  IS      1830(T)  I
IALFA   0020(P)  IBETA   004A(P)  IEUNIT  190C(T)  IIUNIT  1D54(T)  ISOURC  21A4(T)  I
IRPC    2AAA(T)  ITU     2B1A(T)  ITA     2B8A(T)  ITS     2BF4(T)  IG      2C68(T)

                                EXTERNAL PROCEDURES

ANDER     EXIT      MIRES     L1480     L158W     L148C     L1485J    L148C3    L132L1
L133H3    L133L2    L133T3    L133L1    L133A2    L123E1    L13351    L133H2    L133H2
L133M3    L13352    L133A3    L13301    L132P2    L13N      L12C      L133T1    L13303
L132P2    L18858    L188C2    L193T2    L133L3    L188Z     L188Y2    L188Y1    L188X

                                     LABEL MAP

1661  00AC  199   0132  130   0135  1100  0144  1101  0166  1700  0702  1102  0
194   0786  1103  0271  180   02B0  181   02DA  182   0301  183   031E  1600  0
180   0AD8  191   0776  190   0741  189   0715  188   06E9  11    0785  192   0
12    079F  1797  07CE  195   07EA  196   18EC  197   0834  193   0852  1791  0
1401  0981  1405  096E  1404  0936  1402  08C5  1323  0A24  1420  097A  14470 1
1403  0A90  113   0AA1  115   0ACE  114   0AB8  116   0AD4  117   0AD9  11122 0
11313 0AFE  11111 0AEE  1111  0AF7  119   0AF0  121   0B08  1112  0BF3  1120  0
1110  0B42  1130  0B9A  1140  0B84  1150  0B06  12000 0F1D  1313  0CFF  1314  0
1323  0096  1410  0C50  1420  0C6E  1430  0CA2  1440  0CC0  1450  0CDE  123   0
122   0D11  1311  0E11  1312  0E00  1210  0065  1330  0084  1340  0002  1350  0
1315  0F19  1316  0F15  1520  0E9E  1510  0E80  1530  0EBC  1540  0EDA  1550  0
1443  0F29  1445  1130  1442  1036  1441  0F2E  1447  123F  1446  1256  1445  1
1752  135F  1753  1361  1501  138E  1504  1359  1503  1460  1505  13CF  1325  1
1502  1460  14480 1925  177   1570  178   1592  1211  174F  1212  1748  1220  1
1812  1AA0  1230  16F2  1250  1710  1260  1792  1656  1753  1664  183C  1448  1
1722  18E9  1359  18FD  1666  1918

PROCEDURE BLOCK LENGTH: 199E
DATA BLOCK LENGTH:      2C00
TOTAL PROGRAM LENGTH:   462E
0 ERRORS
```

```
      SUBROUTINE ORDER(ARRAY,INDEX,NSIZE,ISWTCH)
C     ROUTINE TO LOGICALLY REORDER A REAL ARRAY BY SUBSCRIPTS
C     UPON EXIT FROM ROUTINE
C     INDEX(1) WILL POINT TO THE LARGEST ELEMENT OF ARRAY IF ORDERING
C        IS DESCENDING OR THE SMALLEST ELEMENT OF ARRAY IF ORDERING IS
C     ASCENDING.
C     INDEX(2) WILL POINT TO THE NEXT LARGEST OR NEXT SMALLEST DEPENDING
C        UPON THE MODE OF OPERATION - DESCENDING OR ASCENDING
C
C     ARRAY - INPUT - REAL ARRAY WHICH IS TO BE ORDERED
C     INDEX - OUTPUT - INTEGER ARRAY THAT CONTAINS POINTERS TO ELEMENTS OF ARRAY
C     NSIZE - INPUT - INTEGER VARIABLE THAT SPECIFIES THE NUMBER OF ELEMENTS
C        IN ARRAY THAT ARE TO BE ORDERED
C     ISWTCH - INPUT - INTEGER VARIABLE THAT SPECIFIES TO MODE OF ORDERING
C        POSITIVE INDICATES ASCENDING ORDER
C        NEGATIVE INDICATES DESCENDING ORDER
C     ZERO INDICATES NO REORDERING
C
      DIMENSION ARRAY(NSIZE),INDEX(NSIZE)

      DO 99 I=1,NSIZE
      INDEX(I)=I
99    CONTINUE
      IF(ISWTCH)10,20,30
10    DO 100 I=1,NSIZE
      DO 110 J=I,NSIZE
      IF(ARRAY(INDEX(I))-ARRAY(INDEX(J)))105,110,110
105   ISAVE=INDEX(I)
      INDEX(I)=INDEX(J)
      INDEX(J)=ISAVE
110   CONTINUE
100   CONTINUE
      GO TO 20
30    DO 200 I=1,NSIZE
      DO 210 J=I,NSIZE
      IF(ARRAY(INDEX(I))-ARRAY(INDEX(J)))210,210,205
205   ISAVE=INDEX(I)
      INDEX(I)=INDEX(J)
      INDEX(J)=ISAVE
210   CONTINUE
200   CONTINUE
20    RETURN
      END
                                        SCALAR MAP

  NSIZE   0006(T)  ISWTCH  0007(T)  I      000C(T)  J      000E(T)  ISAVE   0014(T)
                                        ARRAY MAP

  ARRAY   0004(T)  INDEX   0005(T)
                                    EXTERNAL PROCEDURES

  RIPSHC    LIB3Z    LIB2Z    LI33LP    LI33R2    RIPSP
                                        LABEL MAP

  I99   0019 I10   0021 I20   002C I30   003F I100  005A I110  0056 I105  C
  1200    009A   1210    0094   1205    007E

PROCEDURE BLOCK LENGTH: 30A3
DATA BLOCK LENGTH:      0015
TOTAL PROGRAM LENGTH:   30B8
0 ERRORS
```

APPENDIX B

INPUT FORMAT CARDS

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APPENDIX C

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Due to the limited availability of many of the reference sources, a cross-reference has been included to facilitate retrieval. The number(s) in parentheses following each reference are keyed to the following list:

Code Number	Available through...
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2	EPA - OAQPS Emission Standards and Engineering Division(ESED)-Associated Personnel
2a	EPA,ESED - Gary D. McCutchen
2b	EPA,OAQPS - Joseph J. Sableski
2c	EPA,ESED - Eric Noble
2d	EPA,ESED - Fred Porter
2e	EPA,SDAD - William Hamilton
2f	EPA,ESED - Susan Wyatt
2g	EPA,ESED - William King
2h	EPA,ESED - Randy Seiffert
3	TRC--The Research Corporation of New England - Thomas G. Hopper
4	Government documents section of State Library
5	Technical section of local library
6	Contractor preparing report
7	Federal Register
8	Department of Commerce
9	Bookstore - technical section
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